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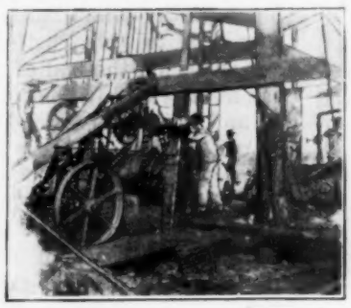
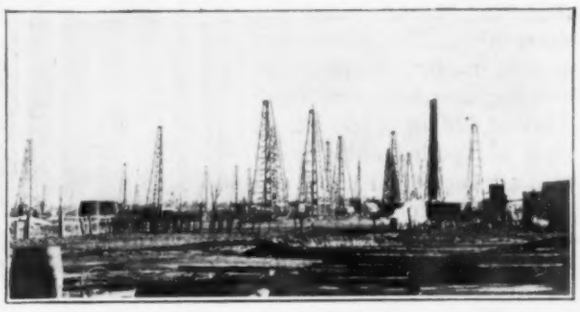
The MECHANICS Of the OIL FIELDS

By FRED H. COLVIN • Editor American Machinist





THE mechanics of the oil fields are both varied and interesting, and, aside from the lure of oil prospecting which seems to get under a man's skin the same as mining, the actual mechanics of the job are of especial interest. Through the kindness of C. E. Reed, vice president and general manager of the Reed Roller Bit Co., Houston, Texas, I was able to visit the well-known Humble field and watch some of the operations at first hand and at the same time have the benefit of Mr. Reed's experience in oil well work. From the minute it is decided to drill a well, money begins to flow out of the treasury with remarkable ease and regularity. The erection of the derrick or frame, averaging about 100 ft. in height, gets away with the first thousand dollars, on which there is usually no salvage as the derrick is always left standing unless it is destroyed by being blown to pieces or by fire. Then comes the drilling machinery, which usually has a steam engine and boiler of from 50 to 60 hp. capacity, a goodly array of chain reduction gearing between the engine and the driving head of what is practically a vertical boring machine. The center view in headpiece shows a little of this. Bevel gears that transmit the motion from horizontal to vertical, drive the toolhead (called a rotary table) that turns the boring tools and the string of pipe which must reach to the bottom of the hole.

Then there is a good-sized water or slush pump (two are usually connected) which forces water or slush down the drill stem and as it returns, coats the side of the hole with mud and also floats out the dirt and pulverized rock as the boring head descends. The driving of the toolhead which turns the drilling bar naturally requires considerable power and is subjected to hard usage, owing to the irregularity in the hardness of the earth and the rocks which are encountered. This necessitates the use of material which will not only be strong enough to resist the stresses, but which can stand an increasing amount of punishment as the hole becomes deeper. The tool is connected to the driving pipe by a rigid socket which is made of a steel forging pierced from the solid. Some idea of the sockets and the quantities in which they are used can be had from Fig. 1, which is a view taken outside the forge shop of the Lucey Manufacturing Co., Houston, Texas. The quantity shown is, in fact, below the normal supply. As the tool goes down, lengths of pipe are added. Only one joint

The drilling of oil wells, and the pumping and handling of oil after it is found, present many mechanical problems, some of which are very closely akin to the work of the machine shop. These include boring and milling, together with sundry other machining operations, in which the cutting tool may be several thousand feet below the earth's surface. The mechanism used in pumping also involves interesting problems in power transmission.

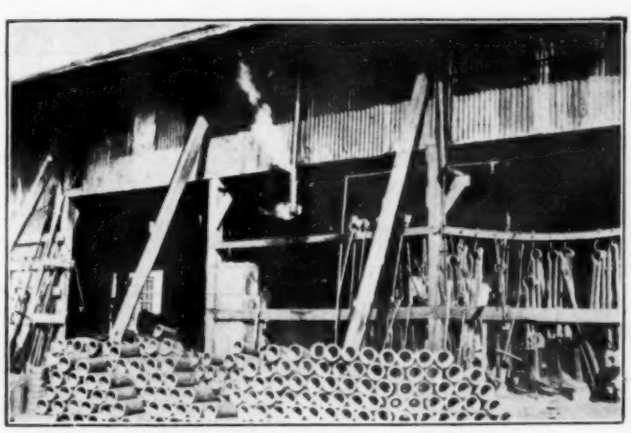


FIG. 1. A PILE OF TOOL JOINTS

can be added at a time. While this is not such a difficult matter at the beginning of the hole, it is increasingly serious as the hole goes down. When we consider that many of these wells reach a depth of over 3,000 ft. (with 4,000 ft. by no means uncommon) the weight of pipe which must be handled becomes an increasingly important figure. The tools are handled by a heavy block and a steel cable, power being obtained from the engine of the power plant. This cost of handling the pipe makes it all the more important that the boring tools remain sharp as long as possible in order to avoid the cost of pulling them out of the well for sharpening. The pulling out process means stopping the drilling or productive work while 3,000 or 4,000 ft. of pipe are pulled out, uncoupled at every 60 or 80 ft. and replaced after the new or sharpened tool has been put in place, before the boring can continue. Here is where more of the treasury fund melts away. Roughly speaking, the cost of drilling may be estimated at a minimum of $5 per ft., which of itself means a tidy little sum on a 4,000- or 5,000-ft. well for only a hole in the ground.

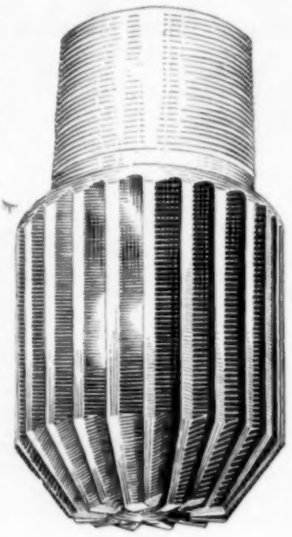


FIG. 2. REAMER FOR SIDE CUTTING

Drilling a well is bad enough when all goes well, but when things begin to happen there is more excitement and uncertainty, not to mention expense, than the average shopman dreams of.

Just before we reached this field, this particular well, which was approximately 2,200 ft. deep, had struck a gas pocket of sufficient pressure to blow the tools out of the well for a considerable distance and to fill the casing which had followed the boring tool down, with rock and all kinds of debris. This obstruction has been jammed in so tightly by the gas pressure that the ordinary drilling head or bit made very little impression on it. Mr. Reed sent for one of his special boring heads to go through this rock. The boring head was successfully used, and after continuing the boring for about 300 ft. more, oil was encountered. It then became necessary to put in a strainer to keep out the sand.

The oil strainers are usually made by drilling a pipe fairly full of holes and then wrapping the outside of it with a wire, winding it around the pipe so as to leave a very slight space between the wires, an opening of only a few thousandths of an inch being the usual practice. The wires are then soldered at intervals so as to retain them in the relative position and after a pointed cap has been placed on the lower end the strainer is complete. Strainers are very necessary to prevent sand from clogging the pipe and also to keep sand out of the pump which forces the oil to the surface.

In the setting of the strainer at this well further difficulties were encountered, due to the end of one of the pipes in the collar being slightly cupped. An attempt to mill off this obstruction, by putting down a 6-in. milling cutter on the end of the pipe, resulted in the loss of the milling tool in the well. Grappling failed to recover it, and, being of hardened steel, it was almost impossible to cut it away with any tools which could be sent down.

Side Tracking

The next step out of the difficulty is what is known as "side tracking" which is done by milling out the side of the pipe for a considerable distance above the obstruction. The operation of side-tracking is usually performed by lodging in the well, above the obstruction, what is known as a "whip stock." This is round at the bottom end and of a diameter slightly under the inside of the pipe and anywhere from 10 to 15 ft. long. It is bevelled off on one side so that at the top it is a thin crescent shape. The whip stock forces the milling tool against the side of pipe to be cut. The tool most frequently used is shown in Fig. 2.

This tool is screwed on the lower joint of the drill stem and cuts out the side of the pipe for a considerable distance, so as to make a comparatively slight angle for the new hole. Through this long hole milled through the side of the casing, a new well-hole is drilled as far down as necessary. This hole through the side of the casing is usually 5¾ or 7¾ in. in diameter, but may be any size; and through it the drilling bit is operated by the drill stem, which is usually 4 in.-pipe. This operation is a very common one in drilling wells by the rotary process.

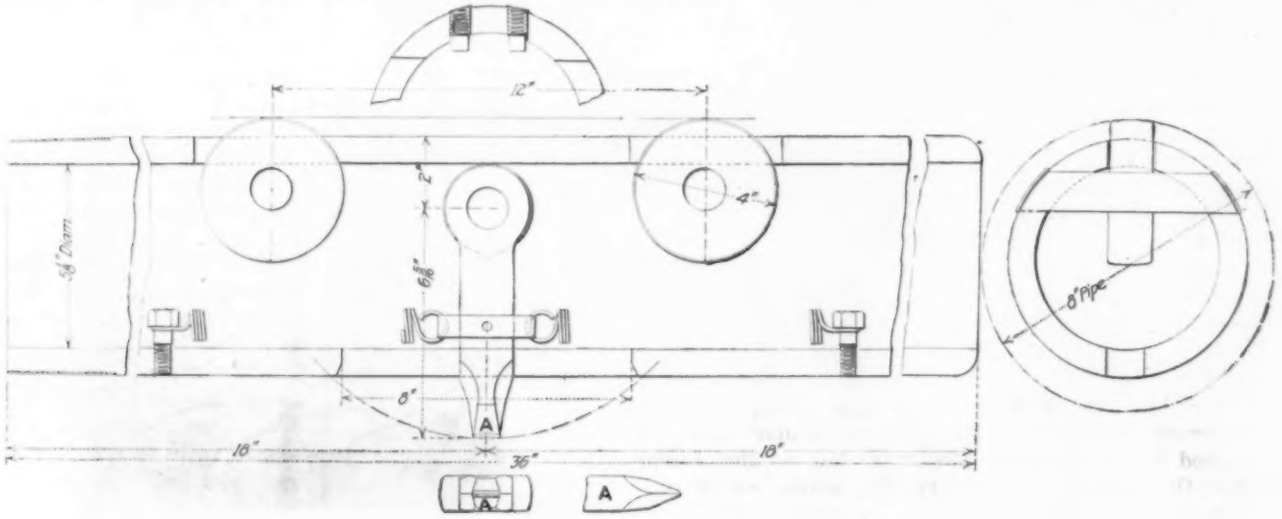


FIG. 3. TOOL FOR PERFORATING CASE UNDERGROUND

620.5 V.53 pt.2

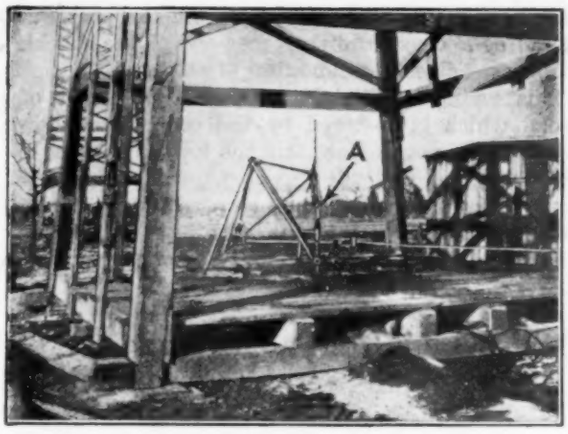


FIG. 4. THE OIL WELL PUMP

Milling cutters of various sizes, shapes and kinds, both internal, external and ends, are used at various times as necessity arises. It also occasionally happens that it is desired to pull out an old casing, and, if this has been in the ground any length of time, it is almost impossible to do so, owing to the pressure. In such cases, a tool, of the type shown in Fig. 3, is lowered into the pipe, and holes are punched in the walls at intervals, so as to allow water to be forced down the pipe and through the holes, washing the outside and loosening the earth which is holding it firmly in place. A little examination will show that, as this tool is lowered into the pipe, the cutter *A* drags or trails, and offers no resistance to its passage. When however, it is desired to punch a hole, the motion of the tool is simply reversed. As it is pulled up the point of the cutter catches the side of the pipe and forces a hole through it. The tool is then raised a short distance with the cutter trailing once more, and, by simply reversing the motion, or forcing it down, another hole is punched, leaving the tool in position to be pushed down the pipe as far as may seem desirable. By this means, it is easy to perforate pipes at any desired depth and many have been recovered by its use.

After the oil well has ceased to gush or flow, the question of pumping has to be looked after. Vast quantities of oil are obtained in this manner after the gas pressure is reduced so the oil will not flow. The pump is a simple affair, usually having a barrel about 6 ft. long, this being sometimes made in 12-in. sections but usually made in one piece. The plunger carries a ball valve top and bottom, the whole thing being very simply constructed. The pump as a whole is shown in Fig. 4 and consists of a skeleton frame fastened to the floor of the derrick. The pump rod *A* is moved up and down by the bell crank, the usual stroke being about 12 in. Suitable linkages connect the end of the bell crank with the pump rod and avoid any tendency to cramping. The pump cylinder and plunger are lowered nearly to the bottom of the well and located with regard to the depth of oil. Motion is imparted to it by means of the connecting cables.

The problem of getting the power to the pump involves considerable rough and ready engineering, which is extremely interesting. At this particular field the method of transmitting power is that of the Joseph Reid Gas Engine, of Oil City, Pa., which consist of a large wheel, Fig. 5, mounted on a vertical shaft and carrying two large eccentrics beneath. From the straps on these eccentrics, cables radiate in as many directions as may be necessary to reach the various oil wells. The throws of the eccentrics are approximately the same as the stroke of the pump and the various methods of getting the cables from the source of power to the pumps, which may be half a mile away across the field, are interesting.

Power in All Directions

Fig. 6, shows a few of these cables coming out from the power house, those shown being only a small portion of the number in actual use. The cables are

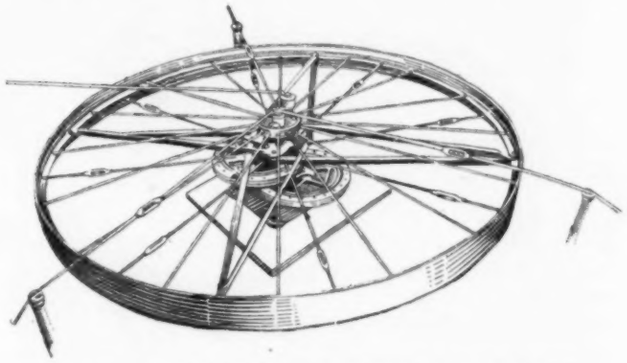


FIG. 5. BAND WHEEL FOR POWER PUMP DRIVE

fastened to the eccentric straps by means of clevises and suitable pins, and if then for any reason it is desired to stop any particular pump, it is only necessary to disconnect one of the cables at a convenient point and fasten it to a short stationary cable which holds it in position ready to be again coupled when desired.

In some instances it is possible to run the cables directly from the power to the pump, even though this be half a mile or more away. In such cases, timbers which are usually somewhat larger than railroad ties are set into the ground and holes bored through them at the proper places to guide the cables and allow them to work freely. The cables are then threaded through these holes and connected to the power wheel.

FIG. 6. CABLES COMING OUT OF POWER HOUSE

FIG. 7. CROSSBEAM FOR REVERSING MOTION

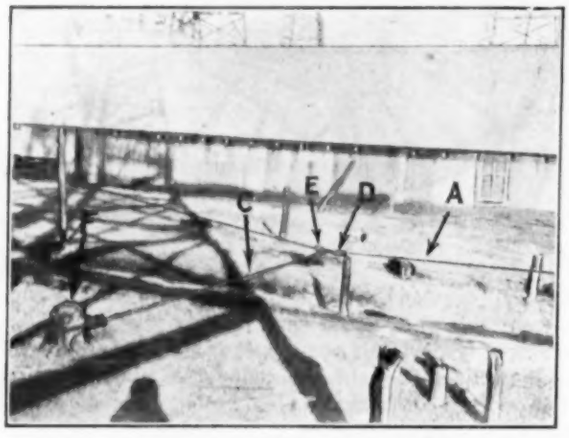


FIG. 8. GETTING AROUND AN OBSTRUCTION

Frequent application of crude oil to the cables as they pass through these supports reduces friction and also delays wear of the hole. The cables are usually kept about 18 in. from the ground.

Figs. 7, 8 and 9 show cases where it has been necessary to transmit power "around the corner" and the method used for so doing. In Fig. 7, the power is brought out on the cable *A*, coupled to the large crossbeam *B*, which is fastened to the post *C* by a wire rope and a cable *D* run from the other end in the direction of the arrow to a well which could hardly be reached in any other way. Each end of the crossbeam rests on timbers as shown, crude oil again supplying the necessary lubricant.

In another case, the well was so located that while a direct line could not be used, the obstruction only required a small deviation. This was secured as shown in Fig. 8. The power line comes out at *A*, coupled into a shackle at *D*. The shackle is held in position by the cable *C*, and moves in a radius from the post *F*. The pump line *E* couples in the other end of the shackle and is almost a direct continuation of the cable *A*.

This swinging slightly reduces the length of the stroke which is restored by the connection shown in Fig. 9. The power line *A* is the lower coupling on the post *B*. The post vibrates and, as the pump line *C* runs off the upper end, the pump receives an increased stroke. These are only a few of the devices used, but give a good idea of the ingenuity displayed in this kind of work.

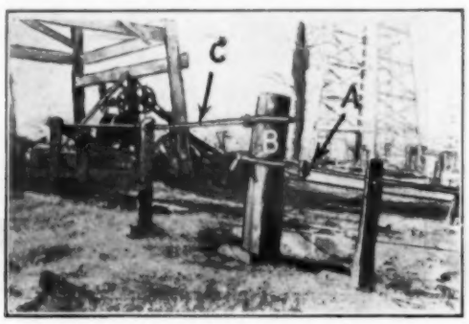


FIG. 9. INCREASING THE STROKE

Device for Grinding Clearance Angles on Tools for the Automatic

BY F. P. ROGERS

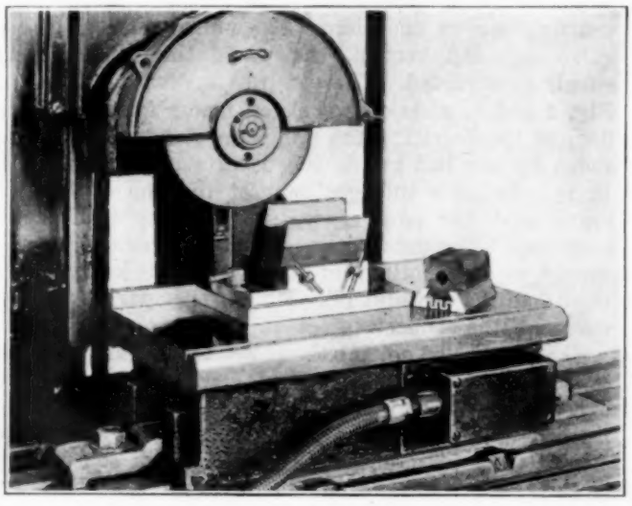
The halftone presented herewith shows a holder for grinding the forming tools commonly used on automatic machines, enabling the operator to produce definite clearance angles with certainty, even though he may remove the tool from the grinding machine many times.

The device consists of carefully finished base with edges ground exactly parallel; a swinging dovetail holder, pivoted at one end on the center line of the base, and graduated at the other end to facilitate setting to any desired angle; and a spring packing piece, or shoe to adapt the holder to smaller sizes of dovetail.

The device is to be used in conjunction with the magnetic chuck, the base being placed against the aligning bar of the chuck to locate it. After the correct setting is once obtained the device may be removed from the machine or the work released from the holder and replaced at any time with certainty of maintaining the angle.

This feature renders it of value for the reason that in the production of tools of the nature for which this device is intended it is frequently desirable to remove the work from the grinding machine for various reasons and during such periods the grinding machine is not "tied up," but may be used for other purposes or by other operators. When the grinding of the tool is to be resumed the holder is replaced on the magnetic chuck with one side against the aligning bar and no "setting up" or trial cuts are necessary.

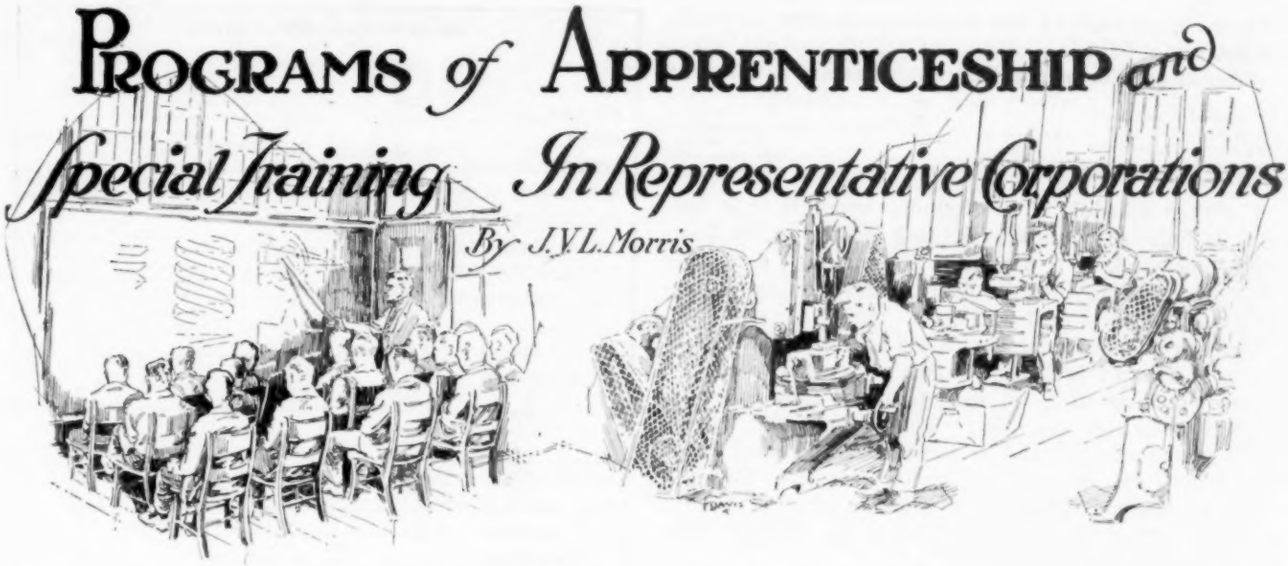
Besides the work for which it was originally intended the device is useful for grinding keys, wedges, or other pieces upon which a definite angle must be obtained.



HOLDER FOR GRINDING CLEARANCE ANGLES

Programs of Apprenticeship and Special Training In Representative Corporations

By J.V.L. Morris



THE firm of R. Hoe & Co. is a long-established manufacturer of printing presses in New York City. For forty-eight years, since 1872, it has maintained an apprentice school as a supplement to the ordinary apprenticeship system in which a skilled trade is taught by the traditional method of working by the side of journeymen on regular factory production. Ninety per cent of the manufacturing administrative force of the plant are said to be graduates of the school, as well as all of the forty to sixty high-grade men employed outside the factory in installing the presses. Thus, the school has high favor with the management of the company, a factor which greatly lessens the danger of exploiting the apprentices by keeping them at machines or processes long after they have learned them, as is frequently the case where foremen and managers are not themselves apprentice trained. It is said that overtime production is not allowed to interfere with attendance at the school, and that apprentices are never laid off during even the dullest seasons.

II. R. Hoe & Co., New York, N. Y.

An apprenticeship system which has withstood the test of time and which is well adapted to use in most machine-building plants, is described here. This system is the traditional form of apprenticeship modernized to meet existing conditions, a school meeting after working hours being the chief feature.

(Part I was published in the Sept. 23 issue.)

To be accepted as an apprentice a boy must be sixteen to eighteen years of age and a graduate of the elementary school, with the preference that he come directly from school rather than after a series of casual employments, during which his experiences lead him too frequently to contract habits of insubordination and shiftlessness. In addition to educational requirements, a simple test for mechanical deftness is imposed by requiring the candidate to put together a mechanical construction toy. A ratio of one apprentice to five journeymen can not be exceeded by agreement with the machinists' union. On this basis there were on April 16, 1920, when the investigation was made, 173 apprentices. About sixty apprentices are taken on each year.

Apprenticeship is offered in the following trades:

Foundry	with 3-year course and	2 enrolled
Machinist	with 4-year course and	160 enrolled
Electrician	with 4 year course and	1 enrolled
Sawsmith	with 3-year course and	5 enrolled
Patternmaker	with 5-year course and	5 enrolled
Total		173 enrolled

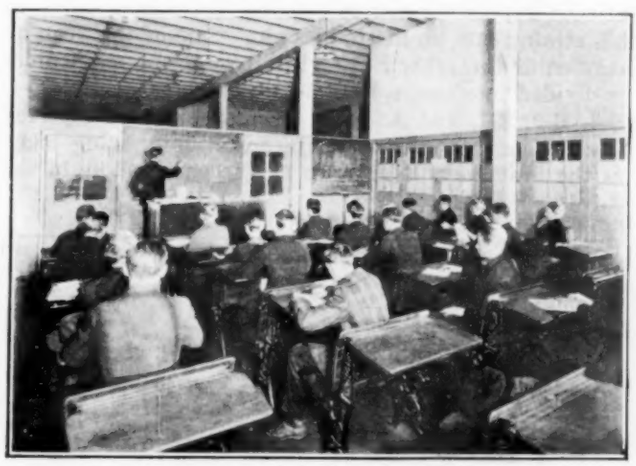


FIG. 8. APPRENTICES IN A CLASS IN MATHEMATICS

FIG. 9. LIBRARY PROVIDED FOR APPRENTICES

Over 90 per cent of the enrollment is seen to be in the machinists' trade.

Rates of pay for machinist apprentices are as follows:

First year—1 c. per hour	$7 04 per wk.
Second year—24c. per hour	10 56 per wk.
Third year—42c. per hour	18 48 per wk.
First six months, fourth year—56c. per hr	24 64 per wk.
Second six months, fourth year—70c. per hr	30 80 per wk.

The shop schedule of the foundry apprentices is outlined as follows: 6 months helping molder on the floor, tempering sand, etc.; 6 months coremaking; 6 months on bench; 9 months on the floor; and 9 months on dry-sand work; a total of 3 years.

For the machinists the schedule is divided into four groups. Group 1 is for one month at general work, tool room or cutting-off machines. Group 2 calls for work at drill press, two months; vise, two months; boring mill, two months; and keying machine and hand monitor, two months, or slotter, two months. Group 3 schedules work at planer, six months; gear cutter, six months; miller, five months; lathe, ten months. The

FIG. 10. APPRENTICES IN A DRAWING CLASS

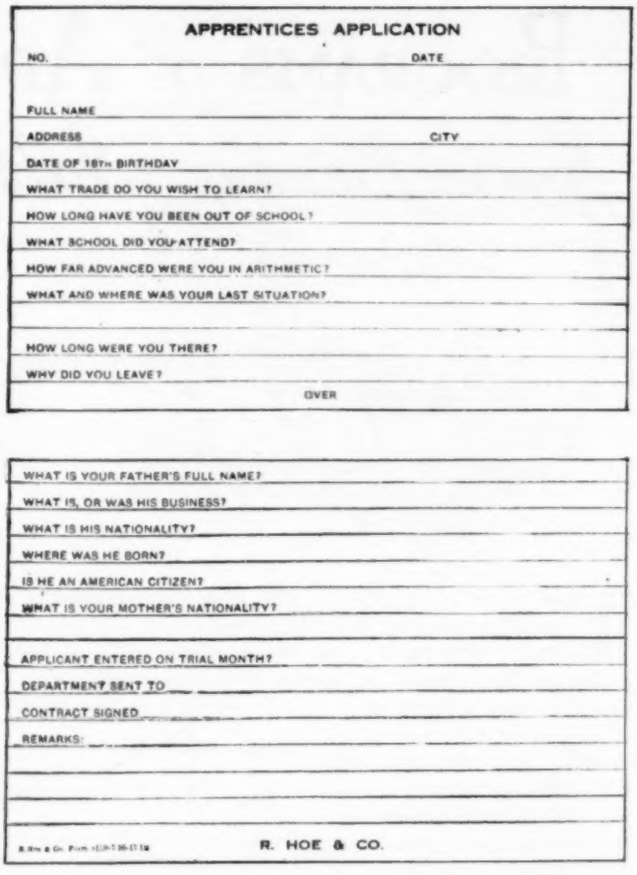
work of group 4 is done at erecting for twelve months. This is a total of 48 months.

Sawmaking is to be considered a special phase of smithing and an interesting example of hand craftsmanship still surviving in industry. The apprentices spend the following periods on the various classes of work: Anvil, six months; punching, 3 months; repairing saws, 3 months; shanks, 3 months; bit room, 3 months; setting and filing, 6 months; hardening, 6 months; anvil, 2 years 6 months. This implies that five years are required before reaching full journeyman's standing.

The patternmakers serve for two years at various classes of work under a master patternmaker, followed by nine months in the foundry to learn the difficulties encountered in casting from a pattern, in order that their later work may be so constructed as to meet foundry requirements. They then return to the pattern shop to complete their time.

School Work of Apprentices

At considerable expense the apprentice school has been installed in a section loft and equipped with three classrooms, a drafting room and a library, besides a lunch room. Views of the school are shown in Figs. 8, 9 and 10. The lunch room was installed so that coffee and sandwiches could be given the boys in the intermission between the closing of the shop at 5 p.m. and the classes, which begin at 5:20 and end at 6:45.



APPRENTICES APPLICATION

NO. DATE

FULL NAME

ADDRESS CITY

DATE OF 16TH BIRTHDAY

WHAT TRADE DO YOU WISH TO LEARN?

HOW LONG HAVE YOU BEEN OUT OF SCHOOL?

WHAT SCHOOL DID YOU ATTEND?

HOW FAR ADVANCED WERE YOU IN ARITHMETIC?

WHAT AND WHERE WAS YOUR LAST SITUATION?

HOW LONG WERE YOU THERE?

WHY DID YOU LEAVE?

OVER

WHAT IS YOUR FATHER'S FULL NAME?

WHAT IS, OR WAS HIS BUSINESS?

WHAT IS HIS NATIONALITY?

WHERE WAS HE BORN?

IS HE AN AMERICAN CITIZEN?

WHAT IS YOUR MOTHER'S NATIONALITY?

APPLICANT ENTERED ON TRIAL MONTH?

DEPARTMENT SENT TO

CONTRACT SIGNED

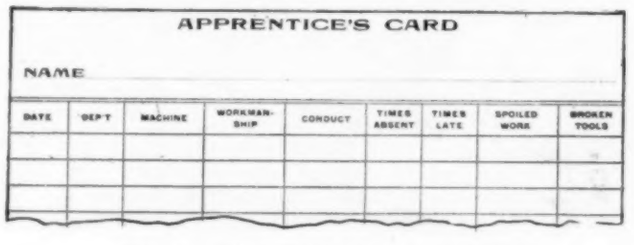
REMARKS:

R. HOE & CO.

FIG. 11. FRONT AND REAR SIDES OF THE APPLICATION CARD

The school personnel consists of a supervisor, a drafting instructor and three teachers who handle the mathematics, English and mechanics. The supervisor, who divides his time between directing the school and office work, is himself a graduate of the school. The drafting instructor is drawn from the company's drafting-room staff and the other instructors are technical graduates with positions in the city, but not otherwise in the company's employ.

Owing to the relatively large size of the school and the fact that all students pursue a uniform course, instruction can be graded to suit the previous training of each apprentice and to provide instruction suited to his attainments no matter at what time of the year he may enter the school. For this reason the curriculum is divided into seven units designated as C-3, C-2, C-1, B-3, B-2, B-1, and A. Ordinary students are expected to complete this in three years, the C units being taken in the first year, B units in the second, and A in the third.



APPRENTICE'S CARD

NAME

DATE	DEPT	MACHINE	WORKMANSHIP	CONDUCT	TIMES ABSENT	TIMES LATE	SPOILED WORK	BROKEN TOOLS

FIG. 12. SHOP-WORK RECORD CARD

The weekly time division or schedule of classes is as follows:

Class C-3

First night	Freehand drawing	1 hr.
	Mathematics—Review of fractions, decimals, ratio, square root, etc.	½ hr.
Second night	Mathematics	1 hr.
	English—Oral and written composition, punctuation and general expression of thought	½ hr.
Third night	English	1 hr.
	Mathematics	½ hr.

Class C-2

First night	Freehand drawing	1 hr.
	Mathematics—Mensuration, simple equations in algebra, problems illustrated by freehand sketches	½ hr.
Second night	Mathematics	1 hr.
	English—Continuation of C-3	½ hr.
Third night	English	1 hr.
	Mathematics	½ hr.

R. H. & Co. Form S141-717-100

R. HOE & CO.'S
Evening School for Apprentices

REPORT FOR TERM ENDING

DATE .....

..... CLASS .....

Attendance .....
Deportment .....
Arithmetic .....
English .....
Geometry .....
Mechanics .....
Mechanical Drawing .....
Average in Studies .....

In order to be advanced, the apprentice's average in Studies must be at least 65.

Shop Rating based on Workmanship
Attendance and Conduct .....

..... FOREMAN

..... HEAD MASTER

FIG. 13. TERM-REPORT CARD FOR APPRENTICE WORK

Class C-1

First night	Drawing—Mechanical drawing commenced	1 hr.
	Mathematics—Constructive geometry. Only such problems considered as can be done with the aid of compass and straight edge	½ hr.
Second night	Mechanics—Heat, air, liquid, power and work with problems and experiments requiring simple apparatus	1½ hr.
Third night	English	1 hr.
	Mathematics	½ hr.

Class B-3

First night	Mechanical Drawing; continued	1½ hr.
Second night	Geometry—Theoretical, with proofs of simpler problems; trigonometry of the right triangle; use of tables of natural functions	1 hr.
	English—Written work, description and exposition	½ hr.
Third night	Mechanics—Mechanical forces and friction	1½ hr.

Class B-2

First night	Mechanics—Gear teeth and gearing	1½ hr.
Second night	Mechanical drawing—Gears, showing characteristics of involute and cycloidal teeth	1½ hr.
Third night	Mathematics—Strength of materials, especially applied to proper proportions and materials for machine parts	1 hr.
	English, continued	½ hr.

Class B-1

First night	Mechanical drawing—Free hand sketching and dimensioning and lettering of plans, sketches, and data for making prints	1½ hr.
Second night	Mechanics—Power transmission as used in a factory. Pulleys, shafting, belting, gearing. Electricity, what it is and how it operates	½ hr.
	English—Report writing and similar work	1 hr.
Third night	Mechanics	1½ hr.

Class A

First night	Mechanical Drawing—Free hand detail drawings for the different parts of a simple machine, such as belt-shifter arrangement, and from these to make up a general Assembly	1½ hr
Second night	Mechanics—Essentials of machine designing	1½ hr

Careful records are kept of the progress of the apprentice both in his shopwork and in the apprentice school, term reports being sent to the parent and prizes being conferred on those with the best records in both shopwork and school at the annual closing exercises held in June.

Apprentice Records

The forms in use by this company for handling the records of its apprentice department seem well adapted to the purposes intended. There is, first, the application form, both front and reverse of which are shown in Fig. 11, which is filled out and filed in the employment department when the boy first seeks entrance into the training school. There is, also, the card, Fig. 12, on which a cumulative record is kept of the apprentice and his work in the different departments of the plant. This is transferred with the apprentice from one department to another as he progresses from one machine or type of work to another. Finally, there is the term report card, shown in Fig. 13, which is filled out and sent to the apprentice's parents each term.

The apparent high quality of the apprentices in this plant and the generous provisions for their instruction, both in the shop and school, would lead one to believe that the management is employing considerable effort in the training of its future mechanics. The program may be commended as an example of satisfactory modernized apprenticeship.

Molding a Drum With Deep Sand Pockets

By M. E. Duggan

An interesting article under the above title appeared on page 1,056, Vol. 52, of *American Machinist*. There are some points in the description of the molding operation that I do not quite understand and therefore I am going to ask some questions; not with intent to be sarcastic, but to add to my fund of knowledge concerning practical pattern making and foundry practice.

From the description I would infer that the pattern was made to mold in green sand, using a core for the central hole. Is this correct?

The depth of the pockets is given in paragraph four as 9 in., but nothing is said about the length and diameter of the drum; thickness of wall; thickness of the web at the bottom of the arms, etc. I would like to know these figures.

When the alterations on the pattern were made that enabled unskilled labor to produce 10 castings per day against 3 castings in the same time with the original pattern and the services of a skilled molder, were the alterations made by the same patternmaker that made the original pattern? If not, was his attention called to the alterations and their result so that he would not make the same mistake a second time?

If I were to make this pattern I would construct it to be molded with the ribs in the drag in green sand, provided there was body enough to the sand to support itself. However, if it was made to mold in green sand with the ribs in the cope no alterations would be necessary to enable the molder to mold the ribs in core; the pattern could still be used as a core box. All that would be necessary in this case would be to suspend the core from the cope with wires.

Motor-Flywheel Drive for Merchant Mill

By J. B. VARELA
Captain Coast Artillery, Fort Monroe, Va.

Designing flywheels for rolling-mill use is not a simple matter; but the author gives in this discussion a treatment of the problem which is concise, yet quite sufficient for ordinary needs, and in such a form that it may be readily adapted to use in actual design work.

IT IS our purpose to present in this article an outline of the calculations necessary to check the electric drive for a 22-in. merchant mill.

The mill is a 22-in., three-high, merchant mill of four stands. It is driven by an induction motor of 1,800 rated horsepower, taking three-phase, 25-cycle, alternating current at 6,600 volts, in connection with a heavy flywheel coupled to the motor shaft and a herringbone gear and pinion, as shown in Fig. 1. In checking this drive two distinct steps must be taken:

First: An investigation must be made of the interaction of the motor and flywheel when the mill is running at maximum capacity, in order to determine the sufficiency of the motor to perform the work required.

Second: An investigation of the stresses induced in the flywheel rim and arms.

I. Formulas for Motor-Flywheel Interaction

(a) Drop in Speed due to load.

The following notation and formula are used in the calculations:

hp = Horsepower of motor;
hp_1 = Friction horsepower;
hp_2 = Maximum horsepower at peak load;
R = R.p.m. at no load (synchronous speed);
R_1 = R.p.m. at full load;
R_2 = R.p.m. at friction load (flywheel speed);
T = Full-load torque at full-load speed;
T_1 = Friction-load torque at friction speed R_2;
T_2 = Maximum torque at friction speed R_2;
T_3 = Maximum torque above T_1;
T_4 = Full-load torque at speed R_2;
T_5 = Maximum torque exerted by flywheel in per cent of full load;
T_6 = Actual torque exerted by flywheel;
S = Per cent of slip at full load;
S_1 = Per cent of slip at friction load;
S_2 = Total slip in per cent;
S_3 = Total slip in r.p.m.;
S_4 = Per cent drop below initial speed with flywheel assisting motor;
S_5 = Per cent drop below friction speed with flywheel assisting motor;
S_6 = Drop in r.p.m. with flywheel assisting motor;
S_7 = R.p.m. drop in speed below synchronous speed;
S_8 = Per cent total actual drop below synchronous speed with flywheel assisting motor;
L = Maximum load above friction in per cent;
Wr^2 = Total inertia effect of motor and flywheel;
t = Length of peak in seconds;
t_1 = Length of interval between peaks in seconds;

Using the above notation we have the following formulas:

$$T = \frac{hp \times 5{,}250}{R_1} \quad (1)$$

$$S = \frac{R - R_1}{R} \quad (2)$$

$$S_1 = \frac{hp_1 \times S}{hp} \quad (3)$$

$$R_2 = R - S_1 R \quad (4)$$

$$T_1 = \frac{hp_1 \times 5{,}250}{R_2} \quad (5)$$

$$T_2 = \frac{hp_2 \times 5{,}250}{R_2} \quad (6)$$

$$T_3 = T_2 - T_1 \quad (7)$$

$$T_4 = \frac{hp \times 5{,}250}{R_2} \quad (8)$$

$$L = \frac{T_3}{T_4} \quad (9)$$

$$S_3 = S_2 R_2 \quad (10)$$

The formulas for calculating the drop below initial speed which takes place with the flywheel assisting the motor are exceedingly complicated. This drop in speed is represented in our notation by S_4; but its value may be readily found without any calculations by using the following factors from the charts published in the *American Machinist* for Mar. 7, 1912, in an article by Messrs. Riker and Fletcher:

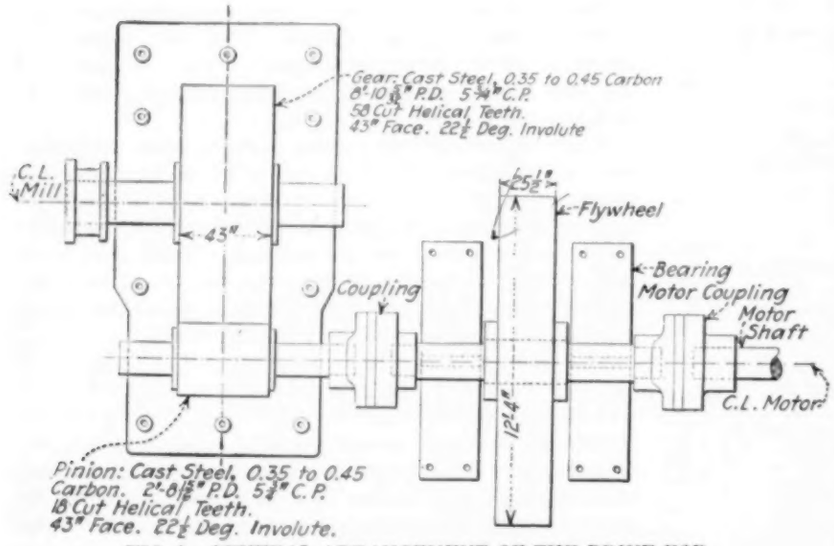


FIG. 1. GENERAL ARRANGEMENT OF THE DRIVE FOR 22-IN. MERCHANT MILL

$$\frac{T_3}{Wr^2};\ S_3;\ \text{and } t$$

The results given here were obtained by that method.

$$S_5 = S_4 \times S_2 \quad (11)$$
$$S_6 = S_5 \times R_2 \quad (12)$$
$$S_7 = S_1 + S_5$$

No attempt is made here to give the derivation of the equations used; but those who care to study the theory are referred to the various papers on the subject published in the transactions of the American Institute of Electrical Engineers.

I (b) Recovery of Speed.

$T_5 = L$ — Friction horsepower in per cent (13)
$T_6 = T_4 T_5$ (14)
$S_7 = S_6 R_2$ (15)

SOLUTION FOR SPEED DROP

In our particular case we proceed as follows, the specifications and conditions of operation being:

1,800-hp. motor;
250 r.p.m. (synchronous speed);
243 r.p.m. at full load;
Slip = 10 per cent of full-load speed when carrying 175 per cent overload;
Friction hp. = 20 per cent of full-load hp., or 360 hp.
Peak load = 6,534 hp.;
Duration of peak load = 0.87 seconds;
Interval between peaks = 2.0 seconds.

Substituting these values in the above formulas we have:

Full-load torque at full-load speed = T =

$$\frac{1{,}800 \times 5{,}250}{243} = 38{,}889 \text{ ft.-lb.} \quad (1)$$

$$\text{Slip at full load} = S = \frac{250 - 243}{250} = 0.028, \text{ or 2.8 per cent} \quad (2)$$

$$\text{Slip at friction load} = S_1 = \frac{360 \times 2.8}{1{,}800} = 0.56 \text{ per cent} \quad (3)$$

Friction-load speed = flywheel speed = R_2 = 250 − 0.0056 × 250 = 248.6 r.p.m. (4)

Friction-load torque at flywheel speed =

$$T_1 = \frac{360 \times 5{,}250}{248.6} = 7{,}603 \text{ ft.-lb.} \quad (5)$$

Maximum torque at flywheel speed =

$$T_2 = \frac{6{,}534 \times 5{,}250}{248.6} = 137{,}986 \text{ ft.-lb.} \quad (6)$$

Maximum torque above friction = T_3 = 137,986 − 7,603 = 130,383 ft.-lb. (7)

Total intertia effect of rotor and flywheel = Wr^2 = 2,260,000, since,

$$\left\{\begin{matrix} Wr^2 \text{ of rotor} = 460{,}000 \\ Wr^2 \text{ of flywheel} = 1{,}800{,}000 \end{matrix}\right\}$$

Full-load torque at flywheel speed =

$$T_4 = \frac{1{,}800 \times 5{,}250}{248.6} = 38{,}013 \text{ ft.-lb.} \quad (8)$$

Maximum load above friction in per cent =

$$L = \frac{130{,}383}{38{,}013} = 3.429, \text{ or } 343 \text{ per cent} \quad (9)$$

Since an overload of 175 per cent causes a drop in speed of 10 per cent of the full-load speed, and we have an overload of 343 per cent, we find that 343 − 175, or 168 per cent additional overload, will cause a further drop in speed of 168 × 0.028 = 4.7 per cent. Consequently, the total drop is 10 + 4.7 = 14.7 per cent, which is the value of S_2.

Total slip below flywheel speed in r.p.m. = S_3 = 248.6 × 0.147 = 36.54 r.p.m. (10)

In order to find S_4, the drop below initial speed which takes place with the flywheel assisting the motor, we enter the previously mentioned chart, using the following factors:

$$\frac{T_3}{Wr^2} = \frac{130{,}383}{2{,}260{,}000} = 0.0576$$

$S_3 = 36.54$ and $t = 0.87$ seconds,

and we find that $S_4 = 36$ per cent of S_3.

$S_4 = 0.36 \times 14.7 = 5.29$ per cent below friction speed (11)

Drop in r.p.m. = $S_6 = 0.0529 \times 248.6 =$ 13.15 r.p.m. (12)

or, $\frac{13.15}{60} = 0.219$ revolutions per second

But we have already found from (3) that the drop in speed due to friction was 0.56 per cent. Hence, the total actual drop in speed is $S_8 = 0.56 + 5.29 = 5.85$ per cent.

Now, since the slip at full load has been found to be 2.8 per cent, the load corresponding to a slip of 5.85 per cent is $\frac{5.85}{2.8} = 2.089$, say 209 per cent. Since the rated overload capacity of the motor is 275 per cent for short intervals, we see that we are well within the safe limit.

SOLUTION FOR RECOVERY OF SPEED

$T_5 = 343 - 20 = 323$ per cent (13)
$T_6 = 3.23 \times 38{,}013 = 122{,}782$ ft.-lb. (14)

In order to determine the per cent of speed recovered we have:

$$\frac{T_6}{Wr^2} = \frac{122{,}782}{2{,}260{,}000} = 0.0543$$
$$S_7 = 0.0585 \times 248.6 = 14.54$$
$$t_1 = 2 \text{ seconds}$$

Entering the chart with the above values it is found that the motor will recover about 90 per cent of its speed.

II. FORMULAS FOR STRESSES IN FLYWHEEL RIM AND ARMS

The flywheel used for this drive is shown in Fig. 2. The high speed at which the motor runs made it necessary to reduce the diameter of the wheel as much as possible, the requirements of a high inertia effect being met by making the wheel very heavy, as shown. The flywheel was made of cast steel with solid rim and

split hub and was carefully balanced. In the investigation of the stresses occurring in the rim and arms, the formulas developed by Von J. Gobel and published in the *Zeitscheift des Vereines Deutchen Ingenieures*, March 26, 1898, were used. These formulas were adapted to the English system and they appear in English units in the following work:

NOTATION

dx = Stress in rim, pounds per square inch;
da = Stress in arm at rim, pounds per square inch;
di = Stress in arm at hub, pounds per square inch;
R = Mean radius in inches;
r = Radius of hub in inches;
α = ½ of angle between arms;
F = Area of rim in square inches;
W = Section modulus of rim;
l = Length of arm in inches;
y = Weight of 1 cu.in. of material (hub);
u = Weight of 1 cu.in. of material (rim);
g = 32.16 × 12 = 385.92 in. per second per second acceleration.
p = Retardation in inches per second per second;
w_a = Section modulus of arm at rim;
w_i = Section modulus of arm at hub;
E = Modulus of elasticity (28,000,000 lb. per square square inch for cast steel);
f = Area of arm in square inches $\{f_i$ at hub$\}$ $\{f_a$ at rim$\}$;
I = Moment of inertia of rim;
i = Moment of inertia of arm (at center)
v = Velocity in inches per second.

Then,

$$X = \frac{2 - \frac{2}{3}\sin^2\alpha - \frac{l^2(2l-3r)}{3R^3}}{\frac{\alpha}{\sin\alpha} + \cos\alpha + \frac{R^2F}{I}\left(\frac{\alpha}{\sin\alpha} + \cos\alpha - \frac{2\sin\alpha}{\alpha}\right) + 4\frac{l}{R}\cdot\frac{F}{f}\sin\alpha} \quad (1)$$

$$dx = \left[\frac{XR}{W}\left(\frac{\sin\alpha}{\alpha} - \cos\alpha\right) + \frac{\cos\alpha\,(\cos\alpha - X)}{F}\right] F\frac{u}{g}v^2 \quad (2)$$

$$da = \frac{1}{f_a}\cdot 2X\sin\alpha\left(F\frac{u}{g}v^2\right) \quad (3)$$

$$di = \frac{1}{f_i}\left[2X\sin\alpha + \frac{f}{F}\cdot\frac{y}{u}\cdot\frac{l(2r+l)}{2R^2}\right] F\frac{u}{g}v^2 \quad (4)$$

$$f = \frac{1}{2}(f_i + f_a), \text{ or } \sqrt{f_i f_a}$$

$$d_3 = \left[\frac{R\sin\alpha}{F} + \frac{R^2}{W}(\alpha - \sin\alpha) + \frac{Rl}{W}\sin\alpha + \frac{l^2(4r+3l)}{24R}\cdot\frac{f}{F}\cdot\frac{y}{u}\right] F\frac{u}{g}p \quad (5)$$

$$d_2 = \frac{1}{w_i}\left[Rl\sin\alpha + \frac{l^2(4r+3l)}{24R}\cdot\frac{f}{F}\cdot\frac{y}{u}\right] F\frac{u}{g}p \quad (6)$$

$$d_4 = \frac{1}{w_i}\left[Rl\sin\alpha + \frac{l^2(8r+5l)}{24R}\cdot\frac{f}{F}\cdot\frac{y}{u}\right] F\cdot\frac{u}{g}p \quad (7)$$

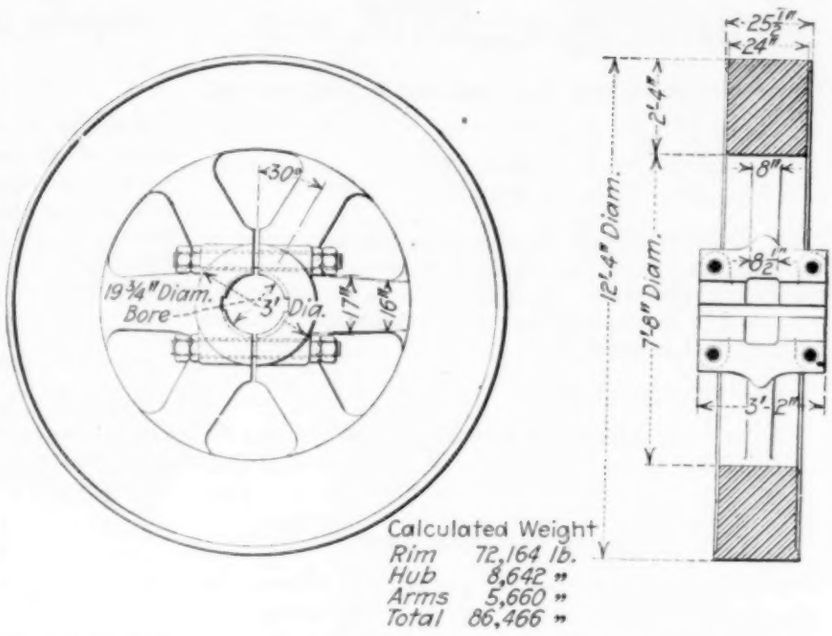


FIG. 2. FLYWHEEL USED FOR 22-IN. ROLLING MILL DRIVE

Formulas (1), (2), (3) and (4) are to be used in the case of wheels running at a constant speed. For wheels running at variable speed we have:

The stress in rim = $dx + d_3$.
The stress in arm at rim = $da + d_3$.
The stress in arm at hub = $di + d_4$.

In order to simplify the calculations when applying these formulas, the following table has been computed for wheels having 4, 6, 8 and 10 arms.

Number of arms, n.	4	6	8	10
$\alpha = \frac{\pi}{n}$	0.78540	0.52360	0.39270	0.31416
$\sin\alpha$	0.70711	0.50000	0.38268	0.30902
$\cos\alpha$	0.70711	0.86602	0.92388	0.95106
$2 - 2/3\sin^2\alpha$	1.66667	1.83333	1.90237	1.93634
$\frac{\alpha}{\sin\alpha} + \cos\alpha$	1.81783	1.91323	1.95005	1.96770
$\frac{\alpha}{\sin\alpha} + \cos\alpha - 2\frac{\sin\alpha}{\alpha}$	0.01719	0.00337	0.00107	0.00054
$\frac{\sin\alpha}{\alpha} - \cos\alpha$	0.19320	0.08990	0.05061	0.03257
$\alpha - \sin\alpha$	0.07829	0.02360	0.01002	0.00514

SOLUTION FOR STRESSES IN WHEEL

In this particular case we have the following values:

$R = 60$	$p = 83$	$I = 4{,}390$
$r = 18$	$w_a = 200$	$i = 1{,}816$
$F = 672$	$w_i = 240$	$v = 1{,}562$
$W = 3{,}136$	$f = 107$	$g = 385.92$
$l = 28$	$f_a = 100$	$n = 6$ arms
$y = 0.283$	$f_i = 113$	$\alpha = 30$ deg.
$u = 0.283$		

Substituting these values in the above formulas we obtain:

$$X = \frac{1.83333 - (28)^2\frac{(2\times 28 + 3\times 18)}{3\times(60)^3}}{1.91323 + \frac{(60)^2\times 672}{4{,}390}\times 0.00337 + \frac{4\times 28\times 672}{60\times 107\times 2}} = \frac{1.70025}{9.843} = 0.172 \quad (1)$$

$$dx = \left[\frac{0.172 \times 60}{3{,}136} \times 0.0899 + \frac{0.86603 \times 0.69403}{672}\right] \frac{672 \times 0.283}{385.92} \times (1{,}562)^2 = 1{,}390 \quad (2)$$

$$da = \frac{1}{100} \times 2 \times 0.172 \times 0.5 \times 672 \times 0.00073 \times 2{,}439{,}844 = 2{,}049 \quad (3)$$

$$di = \frac{1}{113}\left(2 \times 0.172 \times 0.5 + \frac{107}{672} \times \frac{28\,(2 \times 18 + 28)}{2 \times (60)^2}\right) \frac{672 \times 0.283 \times 2{,}439{,}844}{385.92} = 2{,}732 \quad (4)$$

$$d_2 = \left(\frac{60 \times 0.5}{672} + \frac{(60)^2}{3{,}136} \times 0.0236 + \frac{60 \times 28 \times 0.5}{3{,}136} + \frac{(28)^2\,(4 \times 18 + 3 \times 28)}{24 \times 60} \times \frac{107}{672}\right) 672 \times 0.00073 \times 83 = 647 \quad (5)$$

$$d_3 = \frac{1}{200}\,(60 \times 28 \times 0.5 + (28^2 \times 85 \times 0.1592)\, 672 \times 0.00073 \times 83 = 175 \quad (6)$$

$$d_4 = \frac{1}{240}\left(60 \times 28 \times 0.5 + \frac{(28)^2\,(8 \times 18 + 5 \times 28)}{24 \times 60} \times 0.1592\right) 672 \times 0.00073 \times 83 = 150 \quad (7)$$

Since this flywheel runs at a variable speed we have:
Total stress on rim = $dx + d_2 = 1{,}390 + 647 =$ 2,037 lb. per square inch.
Total stress on arm at rim = $da + d_3 = 2{,}049 +$ 175 = 2,224 lb. per square inch.
Total stress on arm at hub = $di + d_4 = 2{,}732 + 150$ = 2,882 lb. per square inch.

These stresses are well within the safe limit allowable for cast steel, and afford an ample margin of security against unforeseen variations of the peak load and the resulting stresses induced in consequence thereof.

The drive just considered, which was designed by the author, has been in operation since the summer of 1914, and it has withstood successfully the most exacting requirements met in modern American mill practice.

Sheet Metal Arc-Welding Machine

By E. A. Thanton

The machine shown in Fig. 1 is used by the General Electric Co., Schenectady, N. Y., for arc-welding corrugated steel tank work. The seams are 116 in. long, and the arc is applied by means of a tapered carbon pencil 6 in. long, $\frac{1}{2}$ in. in diameter at the large end and $\frac{1}{8}$ in. at the arc end. This concentrates heat where

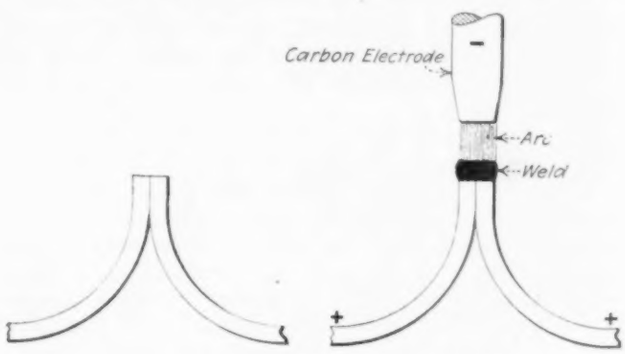


FIG. 2. HOW THE METAL EDGES ARE WELDED

wanted. No metal is supplied to the weld, as the arc is employed simply to fuse the upturned edges as shown in Fig. 2. The metal welded is $\frac{1}{16}$ and $\frac{3}{32}$ in. thick.

The speed on $\frac{1}{16}$-in stock is $5\frac{1}{2}$ in. per minute with a d.c. current of 45 amp., and 75 volts. On $\frac{3}{32}$-in. stock the speed is the same but 70 amp. and 75 volts d.c. current is used.

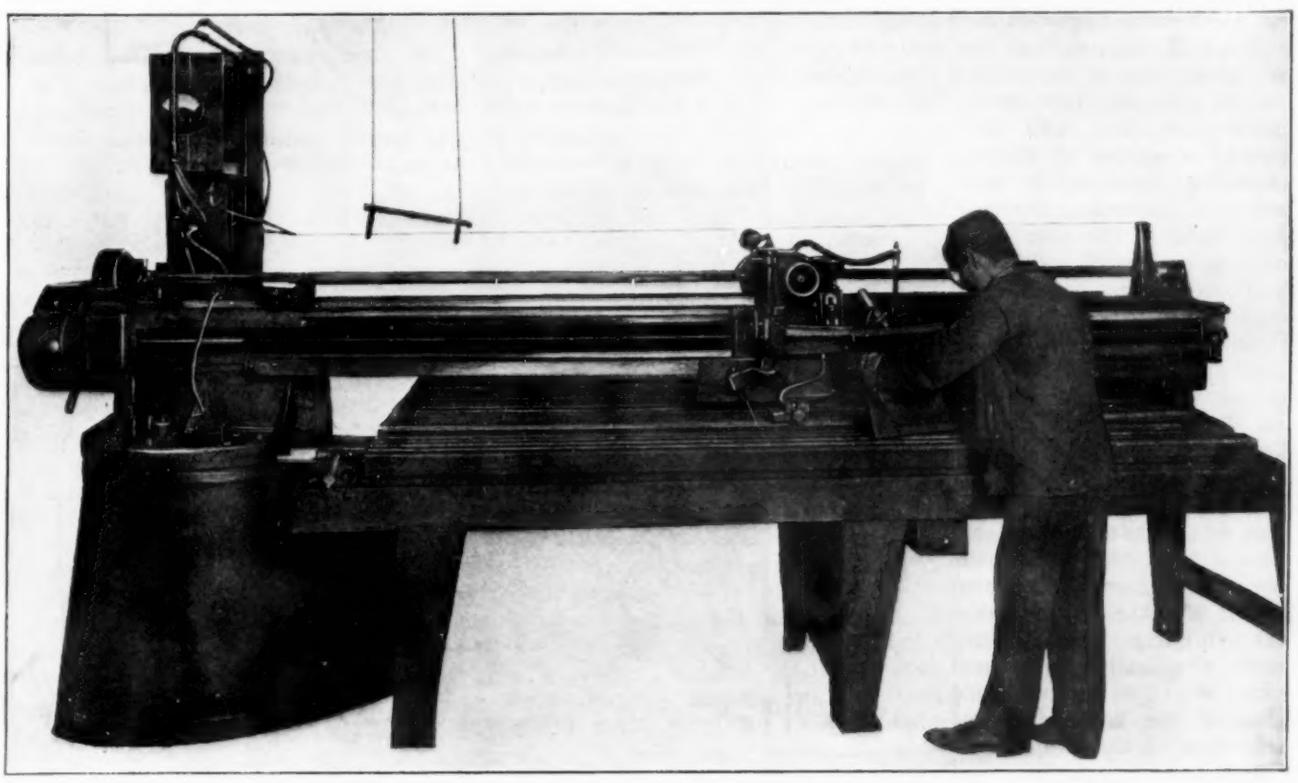


FIG. 1. CARBON ELECTRODE ARC SEAM-WELDING MACHINE

Die Sense

BY EDMOND REMACLE

It is well known by die makers, die users and hardeners that the most critical time in the making of a die is in the hardening and tempering process. No matter whether the die is hardened by the one who made the die or by an expert hardener, there is always the element of doubt as to the successful result.

After a close study of the question for a period of over twenty-five years I have concluded that a word is due both for the relief of the hardener and to prevent the knock often given to some really excellent grade of steel.

When it so happens that a die comes from the quenching bath and is found to be cracked or badly warped, the fault is invariably traced either to the steel or the method of hardening, and while both may be to blame in a number of cases, the real fault in most of the cases may be traced to careless handling by the die maker who has really handed a lemon to the hardener.

I have several times noticed that where two workmen completed dies almost similar in shape and made of steel cut from the same bar and given identical heat treatment, that one die would come out perfect or nearly so, while the other would be cracked or warped, sometimes beyond usefulness, and have finally concluded that the greatest element of fault was in the method of the die-maker.

After having drilled within the lines to remove the core, one workman will leave so much wall between the holes that considerable drift work is necessary to break through the wall, while the other will drill so close that no difficulty is found in breaking through.

Then after the core is removed one will use a chisel to level the rough surface to the grooves left from the drill, while the careful one will rough-file to within a reasonable distance of the line, or where large enough he will remove the stock in a shaper.

We will suppose that the one who uses the chisel breaks a piece off beyond the line, or gouged too deep to clean up, and then brings out his "put-on" tool to cover the fault and then grinds or shapes off the top so the scar will not be seen, while the careful one will have filed to the line without touching with a chisel or drift. Now, when both dies are turned over to the hardener they both look alike to him until they come from the quenching bath, when one will be warped if not cracked, and the other will be reasonably straight and solid.

Then the foreman either blames the hardener or condemns the steel, while the die maker will condemn both. But the truth is that the chipping and drifting have practically compressed the steel in places and changed the homogeniety of the mass, so that while heating, distortion took place, and when quenching a tension was caused which destroyed the shape or cracked the die, while the filed die stood a 100 per cent chance of coming out of the bath in good condition.

While we know that some steel is not fit to make a good die, the abolition of the chisel and drift will help even the poor steel, and their use will destroy the chance of good steel and worry the hardener who takes the die at its face value without a knowledge of the previous handling.

Expanding Arbors

BY E. A. DIXIE

The dimensioned illustrations herewith give the details of expanding arbors from $\frac{3}{4}$ to $1\frac{7}{16}$ in., rising by increments of $\frac{1}{16}$ in. It will be noted that the included angle of the taper for expanding the bushings is 16 degrees. This taper has been found to be entirely satisfactory in practice.

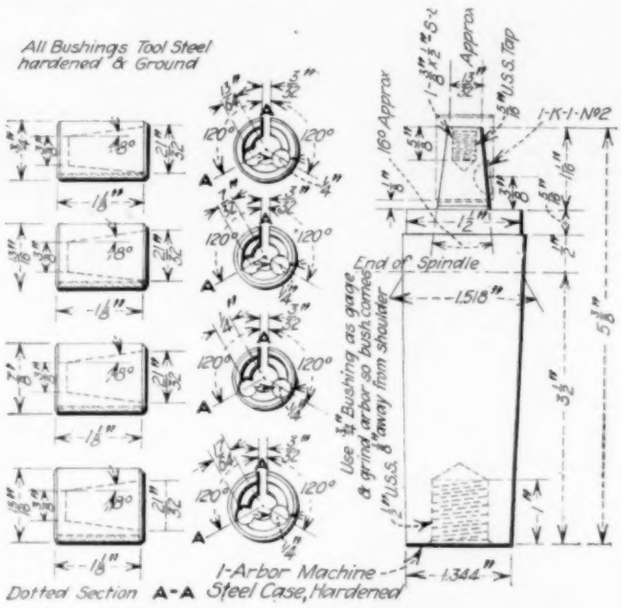

All Bushings Tool Steel hardened & Ground
Dotted Section A-A
1-Arbor Machine Steel Case, Hardened
End of Spindle
1.344"
1.518"
1-K-1-№2
U.S.S. Tap
16° Approx
Use ¼" Bushing as gage & grind arbor so bush comes ⅛" away from shoulder

FIG. 1. EXPANDING ARBOR WITH BUSHINGS FROM $\frac{3}{4}$ TO $1\frac{7}{16}$ IN.

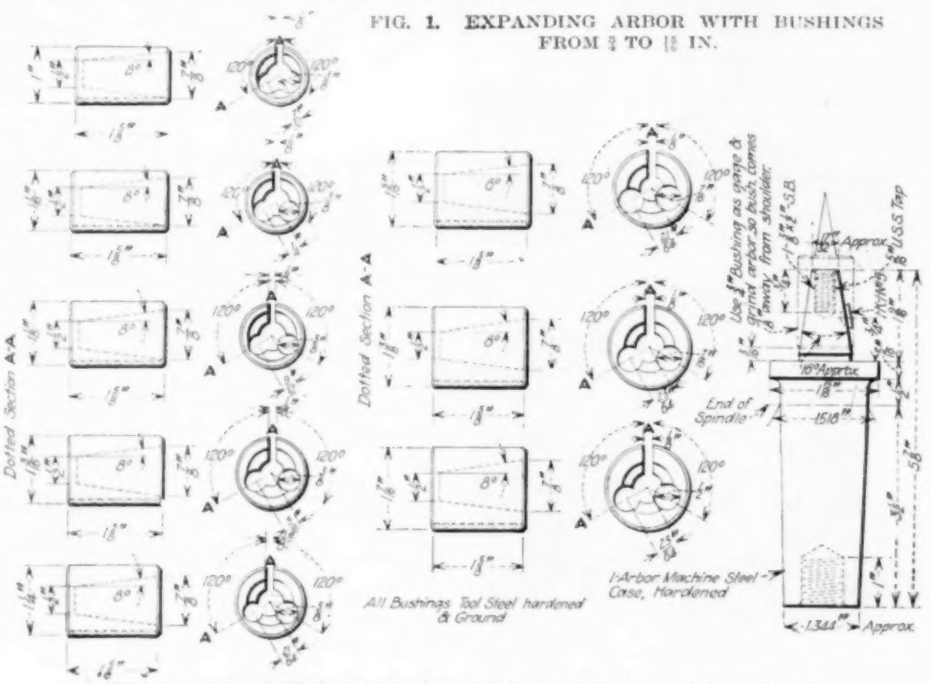
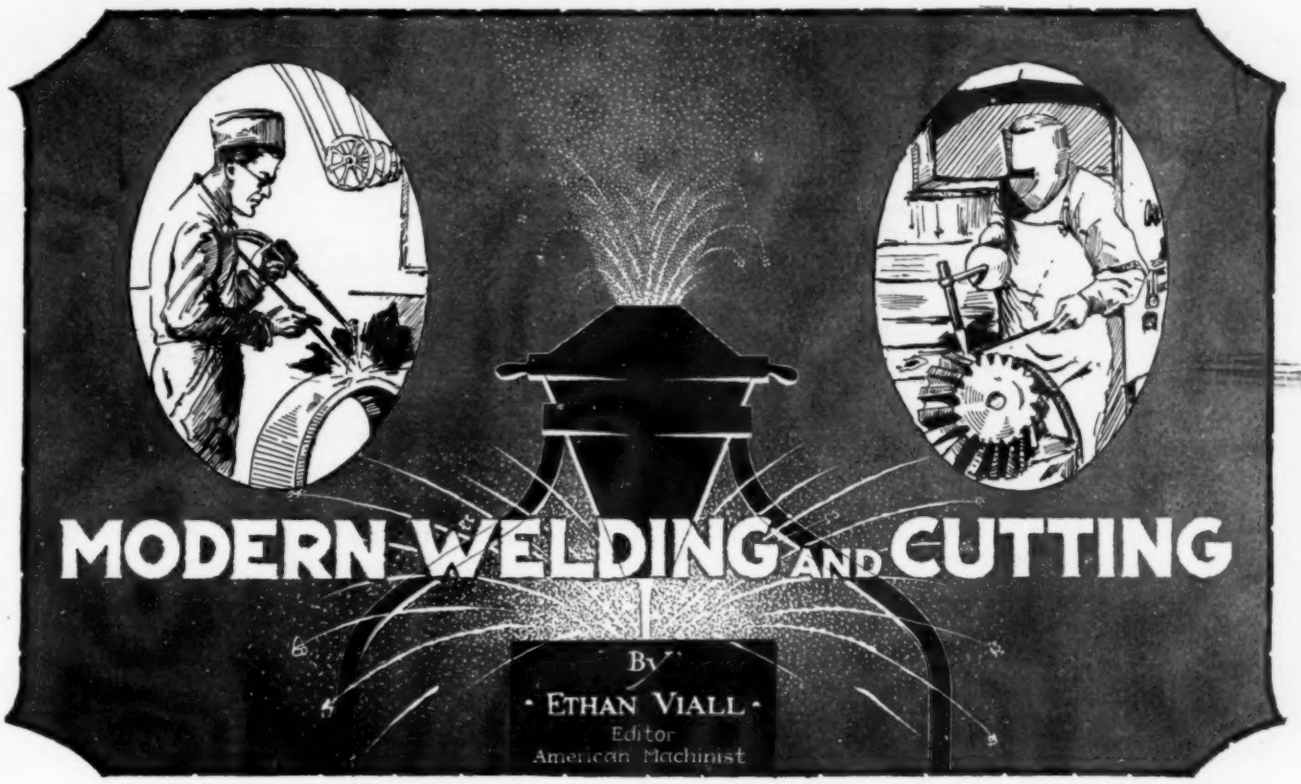

Dotted Section A-A
All Bushings Tool Steel hardened & Ground
1-Arbor Machine Steel Case, Hardened
End of Spindle
1.344"
1.518"
U.S.S. Tap
10° Approx
Use ¼" Bushing as gage & grind arbor so bush comes ⅛" away from shoulder

FIG. 2. EXPANDING ARBOR WITH BUSHINGS FROM 1 TO $1\frac{7}{16}$ IN.



IT IS presumed that the welder has a fair knowledge of the different processes of both carbon and metallic arc welding, gained from reading the previous articles or from actual experience. However, we will recapitulate to some extent in order to make everything as clear as possible. Then we shall give some examples of the proper procedure in making welds of various kinds. For the descriptions and drawings we are principally indebted to the Westinghouse Electric and Manufacturing Co., the Lincoln Electric Co., and the Wilson Welder and Metals Co.

XXVIII. Arc Welding Procedure*

Leading up to this article there have been two others, not listed in the series. These are "Training of Arc Welders," Vol. 52, page 837, and "Carbon Electrode Welding and Cutting," page 499. The last article of this series appeared on page 499.

(PART XXVII was published in the Sept. 23 issue.)

In order to prepare the metal for a satisfactory weld, the entire surfaces to be welded must be made readily accessible to the deposit of the new metal which is to be added. In addition, it is very essential that the surfaces are free from dirt, grease, sand, rust or other foreign matter. For this service, a sandblast, metal wire brush, or cold chisel are recommended.

During the past few years great progress has been made in the improvement of steels by the proper correlation of heat treatment and chemical composition. The characteristics of high-carbon and alloy steels, particularly have been radically improved. However, no amount of heat treatment will appreciably improve or change the characteristics of medium and low-carbon steels which comprise the greatest field of application for arc welding. Furthermore, the metal usually deposited by the arc is a low-carbon steel often approaching commercially pure iron. It must be evident therefore that the changes of steel structure due to the arc-welding process will not be appreciable and also that any subsequent heat treatment of the medium- or mild-steel material will not result in improvements commensurate with the cost.

Pre-heating of medium and mild steel before applying the arc is not necessary and will only enable the operator to make a weld with a lesser value of current.

Cast-iron welds must be annealed before machining other than grinding is done in the welded sections. This is necessary because at the boundary between the original cast iron and the deposited metal there will be formed a zone of hard, high-carbon steel produced by the union of carbon (from the cast iron) with the iron filler. This material is chilled quite suddenly after the weld is made by the dissipation of the heat into the surrounding cast iron which is usually at a comparatively low temperature.

Although it is not absolutely necessary to pre-heat cast iron previous to arc welding, this is done in some instances to produce a partial annealing of the finished weld. The pre-heating operation will raise the temperature of a large portion of the casting. When the weld is completed, the heat in the casting will flow into the welded section, thereby reducing the rate of cooling.

The maintenance of the proper arc length for the metallic electrode process is very important. With a long arc an extended surface of the work is covered probably caused by air drafts with the result that there is only a thin deposit of the new metal with poor fusion. If, however, the arc is maintained short, much

*For author's forthcoming book "Welding and Cutting." All rights reserved.

better fusion is obtained, the new metal will be confined to a smaller area, and the burning and porosity of the fused metal will be reduced by the greater protection from atmospheric oxygen afforded by the enveloping inert gases. With increase in arc length, the flame becomes harder to control, so that it is impossible to adequately protect the deposited metal from oxidation.

The arc length should be uniform and just as short as it is possible for a good welder to maintain it. Under good normal conditions the arc length is such that the arc voltage never exceeds 25 volts and the best results are obtained between 18 and 22 volts. For an arc of 175 amp. the actual gap will be about $\frac{1}{8}$ inch.

Manipulation of the Arc

The arc is established by touching the electrode to the work, and drawing it away to approximately $\frac{1}{8}$ in., in the case of the metallic electrode. This is best done by a dragging touch with the electrode slightly out of vertical. The electrode is then held approximately at right angles to the surface of the work, as the tendency is for the heat to go straight from the end of the electrode. This assures the fusing of the work, provided the proper current and arc length have been uniformly maintained.

A slight semicircular motion of the electrode, which at the same time is moved along the groove, will tend

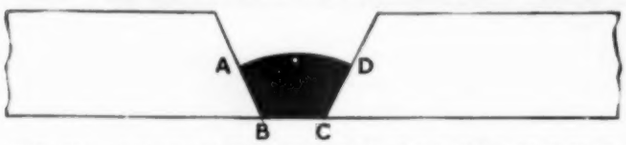


FIG. 336. DIAGRAM ILLUSTRATING FILLING SEQUENCE

to float the slag to the top better than if the electrode is moved along a straight line in one continuous direction and the best results are obtained when the welding progresses in an upward direction. It is necessary in making a good weld to "bite" into the work to create a perfect fusion along the edges of the weld, while the movement of the electrode is necessary for the removal of any mechanical impurities that may be deposited. It is the practice to collect the slag about a nucleus by this rotary movement and then float it to the edge of the weld. If this cannot be done, the slag is removed by clipping or brushing with a wire brush.

Filling Sequence

When making a long seam between plates, the operator is always confronted with the problem of expansion and contraction which cause the plates to warp and produce internal strains in both plates and deposits.

The method of welding two plates together is shown in Fig. 336. The plates are prepared for welding as previously described, and the arc is started at the point *A*. The welding then progresses to the point *B*, joining the edges together, to point *D* and back to *A*. This procedure is carried on with the first layer filling in a space of 6 or 8 in. in length, afterward returning for the additional layers necessary to fill the groove. This method allows the entire electrode to be deposited without breaking the arc, and the thin edges of the work are not fused away as might be the case if the operator should endeavor to join these edges by moving the electrode in one continuous direction. This method also prevents too rapid chilling.

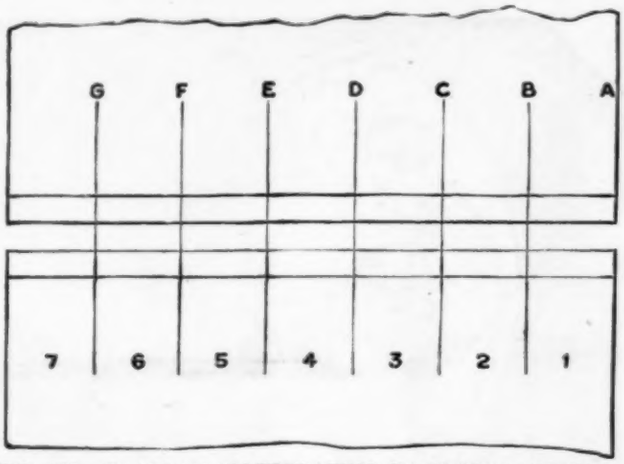


FIG. 337. DIAGRAM ILLUSTRATING BACK-STEP METHOD

When making a long seam weld, for example, a butt weld between two plates, the two pieces of metal will warp and have their relative positions distorted during the welding process, unless the proper method is used.

A method was devised and has been successfully put into operation by E. Wanamaker and H. R. Pennington, of the Chicago, Rock Island and Pacific R.R. By their method the plates are fastened together by light tack welds about 8 in. apart along the whole seam. The operator then makes a complete weld between the first two tacks as described in the preceding paragraph, and, skipping three spaces, welds between the fifth and sixth tacks and so on until the end of the seam is reached. This skipping process is repeated by starting between the second and third tacks and so on until the complete seam is welded. The adoption of this method permits the heat, in a restricted area, to be dissipated and radiated before additional welding is performed near that area. Thus the weld is made on comparatively cool sections of the plates which keeps the expansion at a minimum.

Another method very similar to the preceding one, is known as the back-step method, Fig. 337, in which the weld is performed in sections as in the skipping process. After the pieces are tacked at intervals of 6 in. or less for short seams, the arc is applied at the second tack and the groove welded back complete to the first tack. Work is then begun at the third tack and the weld carried back to the second tack, practically completing that section. Each section is finished before starting the next.

Fig. 338 shows the procedure of welding in a square sheet or patch. Work is started at *A* and carried to *B* completely welding the seam. In order that work may next be started at the coolest point, the bottom seam is completed starting at *D*, finishing at *C*. The

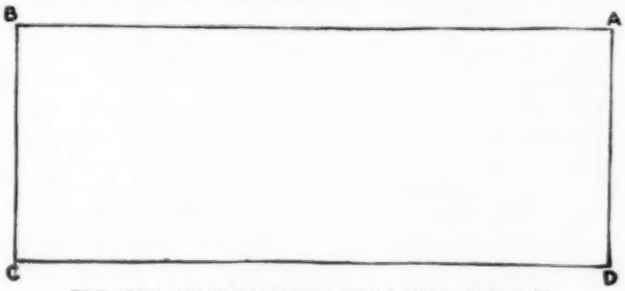


FIG. 338. DIAGRAM ILLUSTRATING SQUARE PATCH METHOD

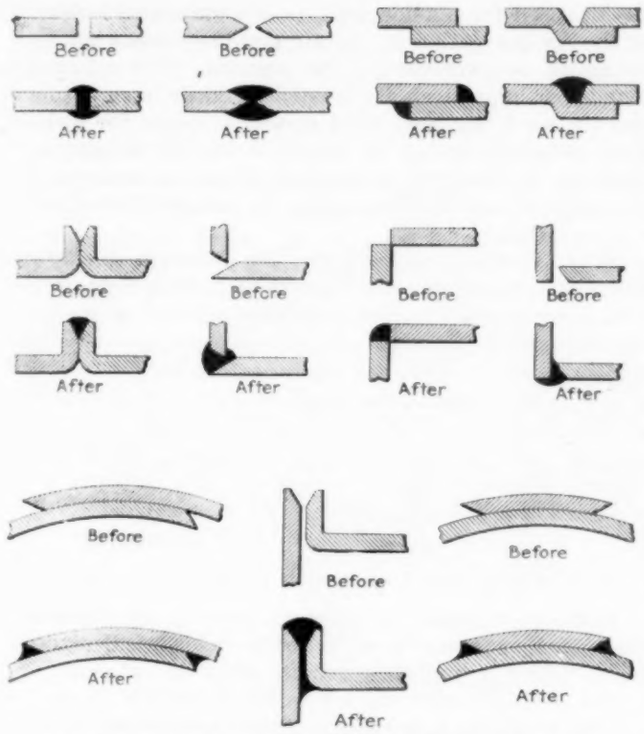


FIG. 339. TYPICAL EXAMPLES OF PREPARED AND FINISHED WORK

next seam is *A* to *D*, starting at *A*. The last seam is finished, starting at *B*, and completing the weld at *C*.

Alternating-Current Arc Welding

Direct current has been used for arc welding because of the fact that it possesses certain inherent advantages that make it especially adaptable for this class of work. However, the use of alternating current for arc welding has found a number of advocates.

When employing this form of energy, use is made of a transformer to reduce the distribution voltage to that suitable for application to the weld.

Inasmuch as the arc voltage is obtained directly from the distribution mains through a transformer, the theoretical efficiency is high compared with the direct-current process which requires the introduction of a motor-generator or resistor or both. The efficiency of the a.c. equipments now on the market ranges from 60 to 80 per cent. The transformer, however, is designed to have a large leakage reactance so as to furnish stability to the arc, which very materially reduces its efficiency when compared with that of the standard distribution transformer used by lighting companies.

It is difficult to maintain the alternating arc when using a bare electrode though this difficulty is somewhat relieved when use is made of a coated electrode.

Quasi Arc Welding

The electrodes used in quasi arc welding are made by the Quasi Arc Weldtrode Co., Brooklyn, N. Y., and are known as "weldtrodes." A mild-steel wire is used with a very small aluminum wire running lengthwise of it. Around the two is wrapped asbestos thread. This asbestos thread is held on by dipping the combination into something similar to waterglass. Either a.c. or d.c. may be used, at a pressure of about 105 volts, with a suitable resistance for regulating the current. The company's directions and claims for this process are: "The bared end of the weldtrode, held in a suitable holder, is connected to one pole of the current supply by means of a flexible cable, the return wire being connected to the work. In the case of welding small articles, the work is laid on an iron plate or bench to which the return wire is connected. Electrical contact is made by touching the work with the end of the weldtrode held vertically, thus allowing current to pass and an arc to form. The weldtrode, still kept in contact with the work, is then dropped to an angle, and a quasi-arc will be formed owing to the fact that the special covering passes into the igneous state, and as a secondary conductor maintains electrical connection between the work and the metallic core of the weldtrode. The action once started, the weldtrode melts at a uniform rate so long as it remains in contact, and leaves a seam of metal fused into the work. The covering material of the weldtrode, acting as a slag, floats and spreads over the surface of the weld as it is formed. The fused metal, being entirely covered by the slag, is protected from oxidation. The slag covering is readily chipped or brushed off when the weld cools, leaving a bright clean metallic surface. In welding do not draw the weldtrode along the seam, as it is burning away all the time, and therefore it is only necessary to feed it down, but do this with a slightly lateral movement, so as to spread the heat and deposited metal equally to both sides of the joint. Care must be taken to keep feeding down at the same rate as the weldtrode is melting. On no account draw the weldtrode away from the work to make a continuous arc as this will result in putting down bad metal. The

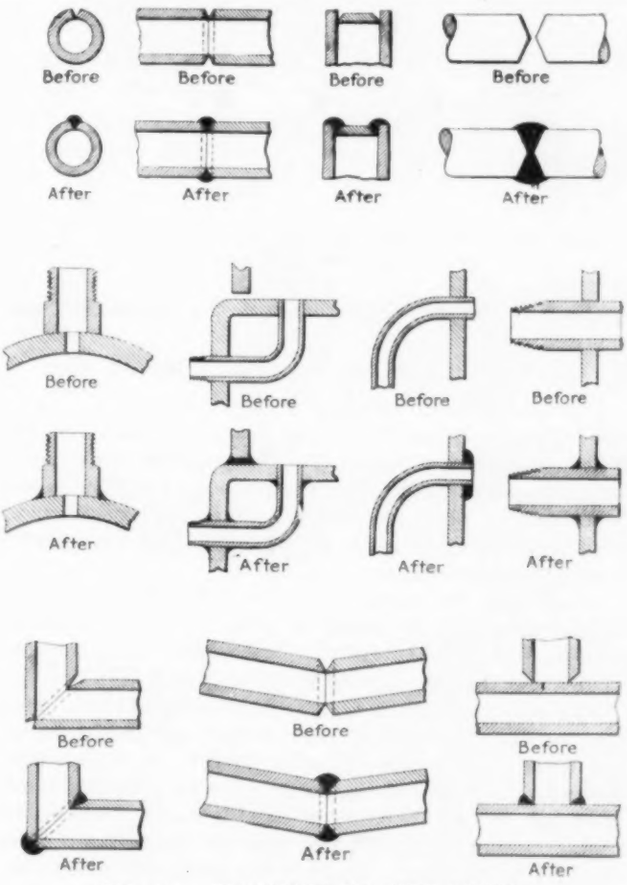


FIG. 340. EXAMPLES OF TUBE WORK

aim should be to keep the point of the weldtrode just in the molten slag by the feel of the covering just rubbing on the work. By closely observing the operation, the molten metal can easily be distinguished from the molten slag, the metal being dull red and the slag very bright red.

The weldtrodes are supplied ready for use in standard lengths of 18 in., and of various diameters, according

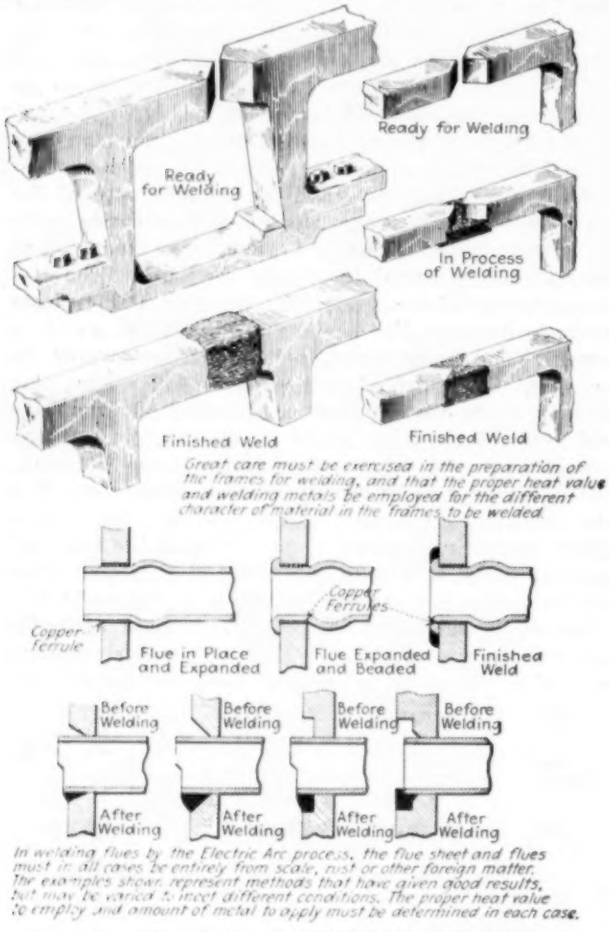

Ready for Welding
Ready for Welding
In Process of Welding
Finished Weld
Finished Weld
Great care must be exercised in the preparation of the frames for welding, and that the proper heat value and welding metals be employed for the different character of material in the frames to be welded.
Copper Ferrules
Copper Ferrule
Flue in Place and Expanded
Flue Expanded and Beaded
Finished Weld
Before Welding
After Welding
In welding flues by the Electric Arc process, the flue sheet and flues must in all cases be entirely free from scale, rust or other foreign matter. The examples shown represent methods that have given good results, but may be varied to meet different conditions. The proper heat value to employ and amount of metal to apply must be determined in each case.

FIG. 341. EXAMPLES OF ELECTRIC WELDING OF LOCOMOTIVE FRAMES AND BOILER TUBES

to the size and nature of the work for which they are required.

Typical Examples of Arc Welding

The examples of welding shown in Figs. 339, 340 and 341 are taken from the manual issued by the Wilson Welder and Metals Co. They will be found very useful as a guide for all sorts of work. Fig. 339 shows miscellaneous plate or sheet jobs, Fig. 340 shows tube jobs, while Fig. 341 gives examples of locomotive-frame and boiler-tube welding.

As a basis for various welding calculations the following data will be found of use: On straight-away welding the ordinary operator with helper will actually weld about 75 per cent of the time.

The *average* results of a vast amount of data show that an operator can deposit about 1.8 lb. of metal per hour. This rate depends largely upon whether the work is done out in the open or in a special place provided in the shop. For outside work such as on boats, an operator will not average in general more than 1.2 lb. per hour, while in the shop the same operator could easily deposit the 1.8 lb. stated above. This loss in speed for outside work is brought about largely by the cooling action of the air and also somewhat by the added inconvenience to the operator. The value of pounds per hour given above is based on the assumption that the work has been lined up and is ready for welding. On the average 70 per cent of the weight of electrodes is deposited in the weld, 12 per cent is burned or vaporized and the remainder 18 per cent is wasted as short ends.

Other figures prepared by the Electric Welding Committee show the possible cost of a fillet weld on a ½-in. plate, using a motor generator set and bare electrodes to be as follows:

Average speed of welding on continuous straight away work	5 ft. per hour
Amount of metal deposited per running foot	.6 lb.
Current 150 amps, at 20 volts = 3 kilowatts.	
Motor generator eff. 50 per cent = 6 kw. ÷ 5 equals	1.2 k.w.h. per 1 ft. run
1.2 k.w.h. at 3 cents per k.w.h. equals	3.6 cents per ft.
Cost of electrode 10 cents per pound and allowing for waste ends, etc., equals	7.2 cents per ft.
Labor at 65 cents per hour equals	13.00 cents per ft.
	23.8 cents per ft.

Suggestions for the Design of Welded Joints

From an engineering point of view, every metallic joint whether it be riveted, bolted or welded, is designed to withstand a perfectly definite kind and amount of stress. An example of this is the longitudinal seam in the shell of a horizontal fire-tube riveted boiler. This joint is designed for tension and steam tightness only and will not stand even a small amount of transverse bending stress without failure by leaking. If a joint performs the function for which it was designed and no more, its designer has fulfilled his responsibilities and it is a good joint economically. Regardless of how the joint is made the design of joint which costs the least to make and which at the same time performs the functions required of it, with a reasonable factor of safety, is the best joint.

The limitations of the several kinds of mechanical and welded joints should be thoroughly understood.

A bolted joint is expensive, is difficult to make steam- or water-pressure tight, but has the distinguishing advantage that it can be disassembled without destruction. Bolted joints which are as strong as the pieces bolted together are usually impracticable, owing to their bulk.

Riveted joints are less expensive to make than bolted joints but cannot be disassembled without destruction to the rivets. A riveted joint, subject to bending stress sufficient to produce appreciable deformation, will not remain steam-or water-pressure tight. Riveted joints can never be made as strong as the original sections because of the metal punched out to form the rivet holes.

There is no elasticity in either riveted, bolted or fusion-welded joints which must remain steam- or water-pressure tight. Excess material is required in the jointed sections of bolted or riveted joints, owing to the weakness of the joints.

Fusion-welded joints have as a limit of tensile strength the tensile strength of cast metal of a composition identical to that of the joined pieces. The limit of the allowable bending stress is also set by the properties of cast metal of the same composition as that of the joined pieces. The reason for this limitation is that on the margin of a fusion weld adjacent to the pieces joined, the metal of the pieces was heated and cooled without change of composition.

Whatever properties the original metal had, due to heat or mechanical treatment, are removed by this action, which invariably occurs in a fusion weld. Regardless of what physical properties of the metal used to form the joint may be, the strength or ability to resist bending of the joint, as a whole, cannot exceed the corresponding properties of this metal in the margin of the weld. Thus, assuming that a fusion weld be made in boiler plate, having a tensile strength of 62,000 pounds. Assume that nickel-steel, having a tensile strength of 85,000 lb. be used to build up the joint. No advantage is gained by the excess 23,000 lb. tensile strength of the nickel-steel of the joint since the joint will fail at a point close to 62,000 lb. If appreciable bending stress be applied to the joint it will fail in the margin referred to.

The elastic limit of the built-in metal is the same as its ultimate strength for all practical purposes, but the ultimate strength is above the elastic limit of the joined sections in commercial structures.

In spite of the limitations of the fusion-welded joint it is possible and practicable to build up a joint in commercial steel which will successfully resist any stress which will be encountered in commercial work.

Strength Factor of Welded Joint

The fundamental factor in the strength of a welded joint is the strength of the material added by the welding process. This factor depends upon the nature of the stress applied. The metal added by the welding process, when subject to tension, can be relied on in commercial practice to give a tensile strength of 45,000 lb. per square inch. This is an average condition; assuming that the metal added is mild steel and that the operation is properly done, the metal will have approximately the same strength in compression as in tension. When a torsional stress is applied to a welded joint the resultant stress is produced by a combination of bending, tension and compression, as well as shear. The resistance of the metal to shear may be figured at $\frac{8}{10}$ its resistance to tensile stress. The metal added by the welding process, with the present development in the art of welding, will stand very little bending stress. A fusion-welded joint made by the electric-arc process must be made stiffer than the adjacent sections in order that the bending stress shall not come in the joint. An electric weld, when properly made, will be steam- and water-pressure tight so long as bending of members of the structure does not produce failure of the welded joint.

Little is known at the present time in regard to the resistance of an electrically welded joint to dynamic stress, but there is reason to believe that the resistance to this kind of stress is low. However, owing to the fact that in most structures there is an opportunity for the members of the structure to flex and reduce the strain upon the weld, this inherent weakness of the welded joint does not interfere seriously with its usefulness.

A few tests have been made of high-frequency alternating stresses and it has been found that using the ordinary wire electrode the welded joint fails at a comparatively small number of alternations, This is of little importance in most structures since high-frequency alternating stress is not often encountered.

The accompanying cuts show a number of typical joints and the arrows indicate the stresses brought to bear on them. The proper way to weld each example is plainly shown.

In *A*, Fig. 342, it will be noted that a reinforcing plate is welded to the joint to make the joint sufficiently stiff to throw the bending outside the weld.

B shows a joint in straight tension. Since no transverse stress occurs the heavy reinforcing of *A* is not required. Just enough reinforcing is given the joint to make up for the deficiency in tensile strength of the metal of the weld.

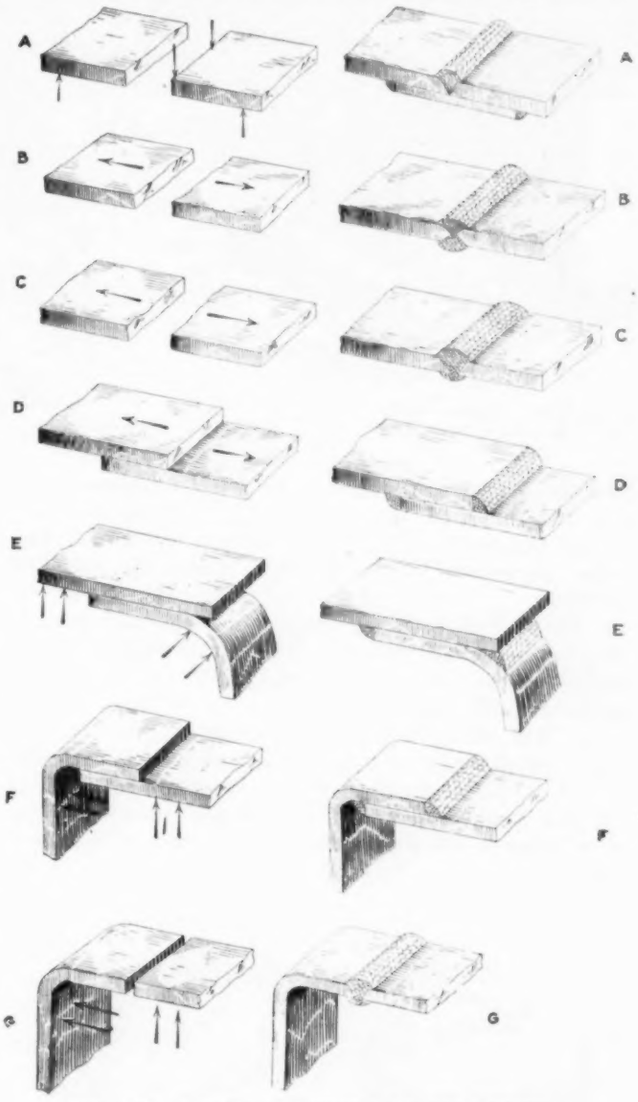


FIG. 342. JOINTS DESIGNED TO OVERCOME CERTAIN STRESSES

C shows another method of building up a joint that is in straight tension. It should be noted that in both *B* and *C* as much reinforcing is placed on one side of a center line through the plates as is placed on the other.

The original form of lap joint such as is used in riveting is shown at *D*. The method shown for welding this joint is the only method which can be used. It cannot be recommended because such a joint, when in straight tension, tends to bring the center line of the plate into coincidence with the center line of the stress. In so doing an excessive stress is placed on the welded material.

E shows the construction used in certain large tanks

where a flanged head is backed into a cylindrical shell. The principal stress to be resisted by the welded joint is that tending to push the head out of the shell. The welding process indicated in the figure will successfully do this. Owing to the friction between the weld and the shell, the outer weld would be sufficient to hold the weld in place for ordinary pressure. For higher pressures the inside weld should be made in addition.

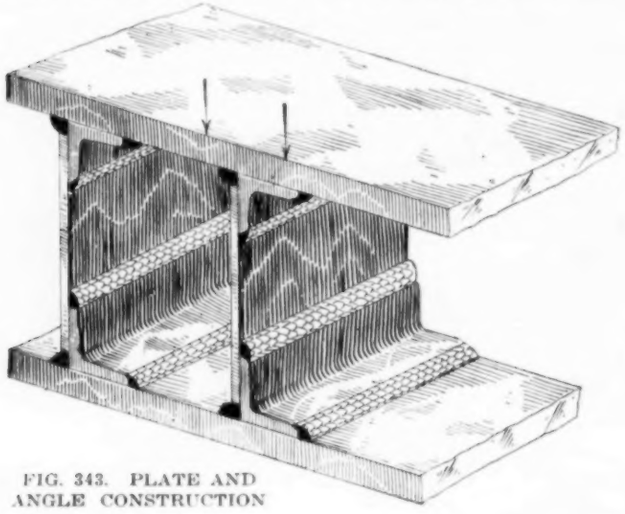


FIG. 343. PLATE AND ANGLE CONSTRUCTION

F and *G* show another method of welding a flanged head to the cylindrical shell. These methods are preferable to the method indicated in *E*. *G* represents the recommended practice.

Fig. 343 shows a plate and angle structure which might be used in ship construction. The particular feature to notice in the welding practice indicated, is that the vertical plates do not reach the entire distance between the horizontal plates. This is merely a method of eliminating difficulties in welding the plates to the angle.

A in Fig. 344 shows a method of welding a head into a cylindrical pipe. The thickness of the head should be approximately twice the thickness of the wall of the pipe. The extra thickness plate is to gain sufficient stiffness in the head to make the stress on the welded material purely shear. The pressure from the inside tends to make the head assume a hemispherical shape. This would place a bending stress on the welded material if the head were thin enough to give at the proper pressure.

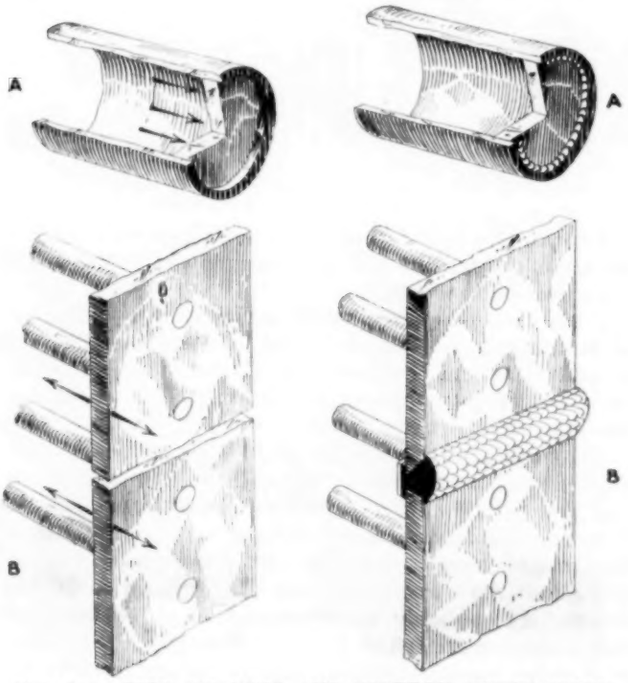


FIG. 344. PIPE HEADING AND FIREBOX SHEET WORK

B shows a method of welding a crack in a fire-box sheet. The thin plate backing introduced at the weld makes the operation very much easier for the operator and produces the reinforcing of the water side of the fire-box sheet which is most desirable.

Section Moduli of Rectangles

BY H. M. SHANDLES

Referring to the article, under the above title by John S. Watts, on page 410 of the *American Machinist*:

The last paragraph of his article indicates that the section modulus of the hollow rectangular section may be obtained from the chart by deducting from the section modulus of the outside rectangle, the section modulus of the interior rectangle. This is seen to be incorrect, because the formula $(BH^3 - bh^3)/6H$ gives the correct section modulus, while the method proposed would give a result $BH^3/6H - bh^3/6h$ which is not the section modulus of a hollow rectangle.

If Mr. Watt intends this as an approximate method only, the results will vary from the exact, an amount depending on the values of h and H.

To illustrate, assume a rectangle of outside dimensions 10 x 4 in. and inside dimensions 8 x 2 in. From the chart 66 — 21 = 45 is the section modulus; from the formula 49.6, showing that in this case the method is approximate within 10 per cent.

Recognition of Individuality in the Shop

The Bullard Machine Tool Co., Bridgeport, Conn., has been a leader in all questions relating to personal relations with the men, and as a result this company has a remarkable spirit of loyalty and co-operation. The latest development is a distinct novelty and one which should have a good effect in promoting individual initiative and increasing the feeling of responsibility.

When the men returned from their week's vacation (with pay) early in September, they found a neat brass frame attached to each machine, containing a waterproof and oil-resisting card as shown herewith.

THIS MACHINE IS IN CHARGE OF

.....

WHO, AS A MATTER OF PERSONAL PRIDE IN FURTHERANCE OF THE BULLARD SQUARE DEAL POLICY, UNDERTAKES TO KEEP IT CLEANED, WELL OILED AND IN FIRST CLASS CONDITION; AND TO IMMEDIATELY REPORT TO HIS FOREMAN ANY INDICATION OF UNDUE WEAR OR REQUIRED REPAIRS.

This is another step away from the plan where men are known only by numbers.

This is a recognition of individuality and a placing of responsibility which cannot fail to further the harmonious relations which already exist.

A HOME FOR APPRENTICES

By Fred H. Colvin
Editor - American Machinist

Perhaps nothing indicates our change in attitude of mind regarding the interdependence of the shop and community life more than the work which is being done to secure proper housing and in other ways improve living conditions. A move in this direction by the Brown & Sharpe Manufacturing Co. marks another step in the march of industrial progress.

THE desire to secure home-like surroundings for the apprentices who come from other localities has prompted the Brown & Sharpe Manufacturing Co. of Providence, R. I., to establish what is known as the Apprentice House in the neighborhood of its plant. While this is in a way a partial return to the old method of having the apprentice live with the proprietor, as was very common in the old days of the small shop, it differs in that it is a real community house, accommodating 27 apprentices and being much more comfortable in every way than the home of the average shop proprietor of fifty years ago.

The building, as shown in the headpiece, is a substantial three-story house and is in a good residential section even though it is only a few blocks from the shop. The ground floor contains the housekeeper's apartment, a large and cheerful living room with an adjoining closed-in sun porch and two sleeping rooms. There are a few single rooms as shown in Fig. 1, but the majority have two or three cots which are extra wide and provided with excellent springs and mattresses. Each boy has his own chiffonier even where the room is occupied by two or three, and suitable chairs and writing tables are provided for those who wish to read, study or write. The living room is shown in Fig. 2, the endeavor being to make it homelike in every way, to have no artificial restrictions and to have every boy feel as though he were at home and to conduct himself accordingly.

The boys have a Victrola, a supply of magazines, and through the extension service of the Providence Public Library, a supply of good wholesome reading matter of various kinds is constantly provided.

The lavatory has been fitted with special regard for neatness and sanitation, a corner being shown in Fig. 3. Shower baths are provided, and both bath and hand towels are supplied. These, together with the bedding, are taken care of by an electrically equipped laundry in the basement.

The house is under the supervision of the Apprentice Department, but is directed by a responsible housekeeper and an assistant. There are no set rules, the boys being simply asked on coming into the house to do as they would in their own homes. No meals are served, this being made unnecessary on account of nearby boarding houses of good quality. The charges are very low compared with the price asked for similar accommodations elsewhere.

The effect of such living conditions cannot fail to be beneficial and, in connection with the training received in the apprenticeship course, tends to promote the dis-

FIG. 1. ONE OF THE ROOMS

FIG. 2. THE LIVING ROOM

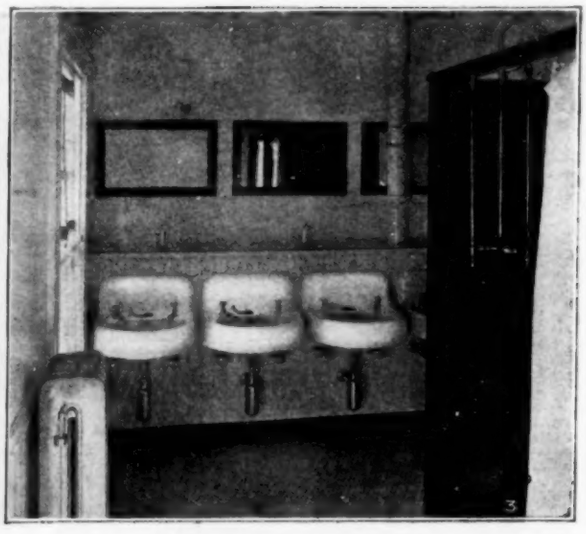


FIG. 3. THE LAVATORY

cussion of mechanical and other shop matters which cannot fail to broaden the viewpoints of the boys fortunate enough to be housed in this way. Such association, coupled with a kindly but not a patronizing interest, is bound to awaken a real shop spirit and to promote the team work which is so desirable in every way. Other homes of this kind will be established as the need for them grows.

Tap-End Sizes of Studs

By W. D. FORBES

The question as to the proper size, shape and fit of the tap-ends of studs has long been discussed from many angles. This article sets forth the views of one who has had many years' experience in the use of studs on a varied line of machines.

IN THE very interesting article on "Tap-End Sizes of Studs" on page 773, vol. 52, of the *American Machinist*, the table of sizes given is well worth a year's subscription to that paper.

I think the use of the wording "tight joint" is misleading when used as it was in connection with the fit of a stud. A tight joint in the minds of most engineers suggests at once a joint which prevents the escape of a gas, fluid, or vapor. There is nothing in a stud that conveys this idea and I should say the proper word to use is "fit," when talking about how a stud is held by its tap end.

A stud is used to hold pieces together. A bolt or capscrew will do this as well as a stud, but a bolt is not always admissable nor proper to employ and a capscrew would possibly injure or destroy an expensive part of a machine by wearing out the tapped thread.

The tap-end of the stud, often called the steam end, is made large, not to make a tight joint but a tight fit, in order to prevent the stud backing out when the nut is cast loose and there is no idea of making the fit steam-tight. There seems to be a reason for making the tap-end of a stud square and chamfering it, as to round it would take a little more length of material and as studs are made in large numbers this would add to the cost. Then, too, the chamfer makes it easier to enter the stud. The rounded end gives a nice finish, but I fail to see why the assertion in the article referred to—that the round end is easier to finish than the square end—is true. I have made thousands of studs and if the tool for parting or cutting off and chamfering was properly made, I found it a very simple job. I think perhaps the idea that the rounded end is easier to finish arises from the fact that the end is usually rounded during the cutting-off operation, so it appears to be a simpler job than cutting off and then chamfering.

A stud is made up of a steam end, cut large and of standard length, a land or plain part of varying length, and the nut end threaded to a somewhat greater length than standard, and the end rounded. To make a stud the following operations must be carried out in either an automatic or hand-screw machine. The end of the rod is cut off and chamfered with a single cross-feed tool, the tap-end thread cut, and then the stud cut off. The partly finished stud is screwed into a carrier or threaded chuck and the nut-end rounded and threaded.

Sometimes the rounded end is polished in the screw machine while at other times it is polished elsewhere. If the stud is not screwed into a carrier it is held by the land.

Now we know that a chain is no stronger than its weakest link, so a stud is no stronger than the cylinder of metal encircled by the bottom of the thread, not going into niceties.

This being so, the land between the threads adds no strength and it is only there as a matter of habit; we have always made studs that way, so we keep to it. The only value of the land is that it saves a certain amount of threading.

I put the question "Why have a large tap-end and a land at all?"

If the stud was rounded on one end, the entire length

threaded and the other end cut off with a chamfer, we would have a cheaper stud and one just as serviceable. The thread being continuous, both ends would be in line. But some one will ask, "How are you going to make a tight fit on the tap-end with such a stud?" That presents no difficulty whatever, as all that has to be done is to tap the hole for the stud with a tap which is undersize and a tight fit then can be made. But there is another way of making a straight stud tight which I will describe later.

This stud of one continuous thread of one size has but one objection, a little more threading would have to be done, but that is made up by the advantage of fewer operations. Of course, the objection which will count most against it is that it does not look right and we are not used to it. As a matter of fact, a stud is not noticed very much. When it is holding a cylinder head in place no one can tell if there is a land between the threads or not; when it is off, the cylinder head is usually wanted back in a hurry and few notice the studs. The only persons, then, who have a good look at the studs are those who set them, and they care very little nowadays what a stud looks like. Of course, a continuously threaded stud would not be advisable if the stud was very long, but for all such studs as are used about engine work I fail to see any objection to its general use.

The taper thread as suggested in the article referred to does not please me for general use. Such a thread is admirable for making a tight joint but I believe its use on stud work would not be as quick, and the tapping of the taper holes would be more troublesome.

A taper tap cuts harder and I have not found that it keeps its size any better, or as well, as a straight threaded tap. It is evident that a stud anchored by a taper thread, if slacked back even a very slight amount, would be all adrift at once. There are places, however, where the taper-end stud should be used and that is where the hole is tapped through, and even in such a position a straight-thread stud could be used if riveted over. The manufacturer of studs who gave the information as to stud making advocates the use of taper tap-ends of studs, yet I notice he states "That the first two or three threads are quite apt to be tapering." This is so, because the fit of the die in the machine is not always perfect, and from other causes. On the tap-ends these partly taper-threads are an advantage as they make it easier to enter the studs in the holes. Another statement which goes to show that one person never has all the experience there is gives the idea that a rounded end on a stud indicates a finger fit for the nut. No one who has had anything to do with studs would be likely to get confused as to which end of the stud was the tap-end, even if there were no chamfered or rounded ends, for the length of the threads (as studs are now made) would show which was which. I think nearly all engineers will say the rounded end is a neater finish than a square one but that it indicates nothing at all as to the fit of the nut.

The *American Machinist* asks the pertinent question, whether the stud should be tight on all the threads on the tap end or be made tight by bringing up on the last thread. Answering this question, I say that the threads should all fit and the stud bring up on the bottom of the tapped hole. This bottoming forces the threads into contact on their upper faces, making a good fit.

The present drill press, properly set and handled, allows a fixed depth of hole to be obtained and maintained without great skill or trouble, and the tapping attachment gives uniform results.

I have had experience in this and know that it is possible to carry out the work as I have outlined, and that a cheaper final result is obtained. If the stud is brought up on the last thread, the top thread in the cylinder, or whatever the piece may be, may be cracked off and lifted up somewhat and a sloppy looking job made of it. The tendency of the stud to be tapered for two or three threads lends itself to bottoming the stud in the hole, as can be well understood by the practical stud setter.

After all has been said and done, I have gone back in my memory and fail to recall ever having had any trouble with studs. One of the companies named in the article in question made studs and screws for me for many years and I never had to complain of any of the work. It has been a source of wonder to me how this company kept so closely to my demands and those of others, and I may add that the taps now on the market keep to standard size in a way that is a matter of astonishment to me, and the very small price asked for taps shows how well their manufacture is conducted.

In all my experience I have never found a machinist's tap in which the threads were eccentric to the shank, as is hinted at in the article.

We can count on having our stud holes tapped to a very close standard if we use our taps properly, and we can also depend on the studs we order being close to size. We have had little to complain of in the past and have little to fear in the future if stud making is carried on just as it has been. The change I propose, of a continuously threaded stud, could only improve matters by being a cheaper product, while the taper tap-end stud neither cheapens nor improves stud making.

How Can We Increase Production?

By Otto Vogetzer

The article under the above head, on page 358 of the *American Machinist*, is both timely and wise. Only the inefficient gain by collective bargaining; the efficient are left without inducement to give the best that is in them, and it is unfair to both sides. Few employers care to deal with a second or third party or go-between, they want to hear from the men direct. The former method creates discord whereas the latter tends to bring both parties closer together. On the other hand how do the men know whether or not their case is properly presented by an outsider?

Collective bargaining may be all right for lines of work that require little or no skill, but it certainly must fail miserably when applied to a trade that has practically no limit for the advancement of individuals who care to make use of the opportunities offered.

"All men are born equal" is not to be interpreted that we should all have equal shares in the distribution of wealth, it means that our shares are to be in direct proportion to our efforts. I believe that those who contrive to get more than their share are the exception rather than the rule. Take away the individual and special compensation, what is left? Certainly nothing that will induce men to produce more.

The survival of the fittest and the elimination of the weakest (and fire the dubs) holds good in the shop as well as in nature. There is no way of getting around that—it is an established truth.

The Calibration of Dimensional Changes of Precision Gage Blocks

By C. G. PETERS and H. S. BOYD
U. S. Bureau of Standards

(Continued from last week's issue)

THE accurate comparison of two gages, *A* and *B*, Fig 11, front, of supposedly the same length, is made by the following method: The two gages are placed side by side in intimate contact, as described before, with the true plane surface of a glass plate *W*. This places the lower surfaces of the two gages in the same plane and the problem is then simply to determine the distance between the planes of the two upper surfaces. This is done by placing a test plate *T* in contact with the gages along the line *CDE* and somewhat inclined to these surfaces. This gives side by side two thin wedge-shaped films. When illuminated and viewed, as shown in Fig. 7, two sets of straight fringes parallel to the edge of the wedge are seen—see top view, Fig. 11. It is only necessary then to determine the difference in thickness of these films at say some adjacent position *K*, to obtain the distance at that point between the planes of the two gage surfaces. If the two gages are of the same length, their upper surfaces will lie in the same plane, so when we pass to the thicker part of the wedge from the line of contact *CDE*, the first fringe a_1 on A will coincide with the first fringe b_1 on *B*, the second with the second, etc. At the point *K* there is coincidence between the third fringes on the two gages. For perpendicular view the thickness of the film at any point is given by equation (2)

$$T_o = N\tfrac{1}{2}(\lambda)$$

In this case the distance T_o from the test plate to each gage would be $\frac{1}{2}(3\lambda)$ at point *K* which means that gages are of equal length. Suppose the gages are unequal in length, say *B* is shorter than *A*. The test plate will come in contact with *A* at the point *D* and with *B* at the point *E*, and the fringes appear, say as in Fig. 12. At *K* we have the second fringe over *A* coinciding with the fourth over *B*. The distance at that point between the test plate and *A* is $\frac{1}{2}(2\lambda)$ and between the test plate and *B* is $\frac{1}{2}(4\lambda)$. Therefore, the distance between the planes of the two gage surfaces is $\frac{1}{2}(2\lambda)$. If we are using a helium lamp for a source $\frac{1}{2}(\lambda)$ is about 0.000011 in., hence, *B* is about 0.00002 in. shorter than *A*. If *A* is a calibrated standard we immediately have the length of the unknown gage *B*. By estimating the displacement of the fringes to one or two tenths of the distance between two bands, measurements of still greater refinement can be made.

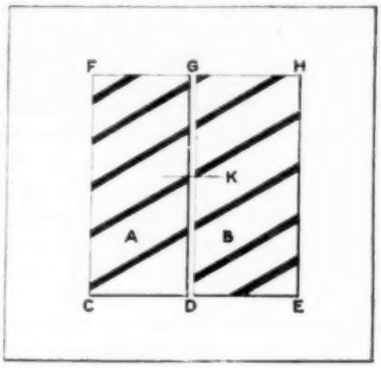
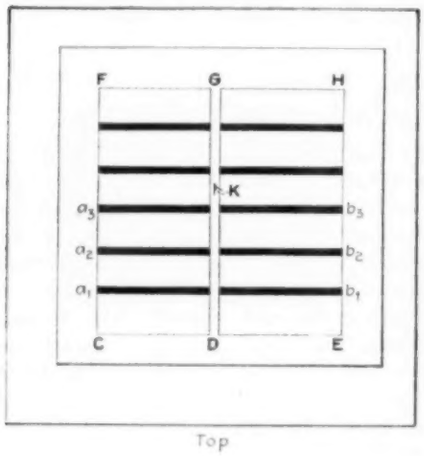


FIG. 12. GAGES OF UNEQUAL LENGTHS



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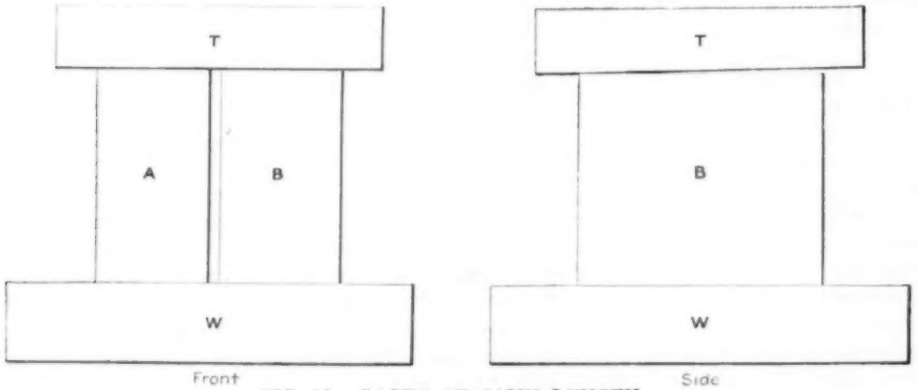


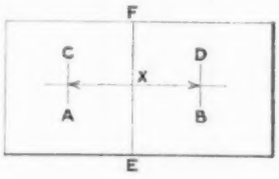
FIG. 11. GAGES OF SAME LENGTH

Angle of View in Comparing Gages

Comparisons of this kind cannot be advisably made beyond the point where the tenth or fifteenth fringe of one gage coincides with the first of the other, that is, when the difference in length of the two gages exceeds ten or fifteen hundred-thousandths of an inch. In making these measurements it is absolutely essential that the fringes be viewed as shown in Fig. 7, that is along the perpendicular to the gage surfaces. If they are viewed at an angle to the perpendicular, then T_o is not equal to $\frac{1}{2}(N\lambda)$ but $T_o = N\frac{1}{2}(\lambda)\sqrt{1 + \tan^2\alpha + \tan^2\theta}$ so an incorrect interpretation of the distance will be made.

With the aid of the Pulfrich instrument previously referred to, comparison between two gages that differ by as much as a half inch in length may be made. With this, the exact number of waves between the test plate and each gage surface near the reference mark *K* is obtained by measuring the fractional excess over a whole wave length for each of a number of different colors and determining from these the number of whole wave lengths by the method of Meggers, which holds for straight fringes as well as Haidinger's rings. With this method the exact length of gages up to a half inch in

length may be obtained. In carrying out this measurement a plane steel surface is used for a baseplate and the distance from the test plate to the baseplate on the one hand and to the upper gage surface on the other determined. The difference in these distances is the length of the gage. The test for parallelism of the two surfaces of the unknown gage B is made along with the length comparison using the same arrangement as shown in Fig. 11. Assuming that the two surfaces of the standard A are plane and parallel, the test plate brought in contact with it along CD gives straight fringes over A which are parallel to CD and equally spaced. If the upper surface of the gage B is parallel to the plane of the upper surface of A, the fringes over B will be parallel to those over A and have the same spacing. If, however, the length of B at GH is less than at DE, then the wedge over B will be steeper than over A and the fringes closer together. Therefore, if seven fringes are observed over B and five over A, as in Fig. 13, GH is $\frac{1}{2}(2\lambda)$ below DE or the gage is about 0.000022 in. shorter on the GH side than on the DE side. Suppose now that the edge GD on B is parallel to the plane of the upper surface of A and the surface of B slopes slightly so that HE is above or below GD. Since the fringes lie along lines of equal thickness of the wedge, they will extend across B at an angle to those over A. If HE is higher than GD they will be deflected toward the open end of the wedge or toward H as shown in Fig. 14. If HE is below GD the fringes on B will be deflected toward the thin edge of the wedge or toward E, in Fig. 15. If we draw a line KL parallel to CE through the end of any fringe over B, the displacement from KL of the other end of that fringe divided by the distance between two consecutive fringes gives the difference in height between GD and HE in half wave lengths. This gives the slant between the upper surface of A and the upper surface of B. If the two surfaces of A are perfectly parallel, it is the slant between the two surfaces of B. If the two surfaces of A are not parallel a corresponding correction must be made to the observed slant to obtain the true slant between the surfaces of B. The slant between the two faces of each of three unknown gages B, C, and D may be accurately determined in the same way if they are brought in contact with the baseplate two at a time, and the slant between the two upper surfaces compared as described above.



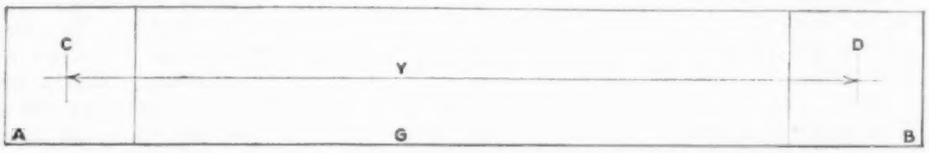


FIG. 16. CALIBRATING END STANDARDS FROM LINE STANDARDS

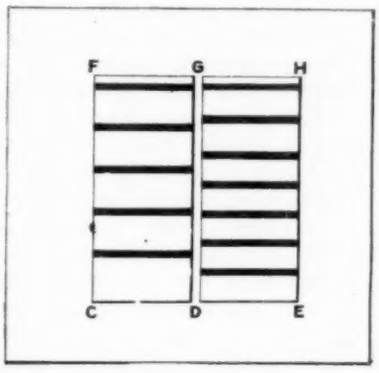


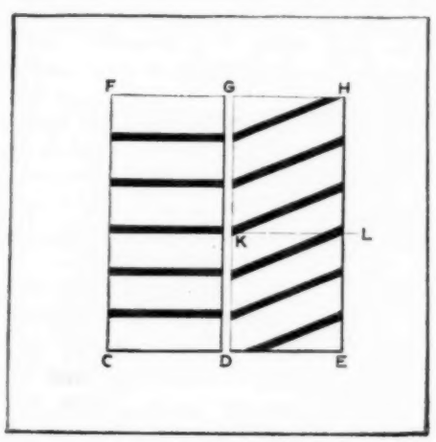
FIG. 13. GAGES HAVING PARALLEL SURFACES

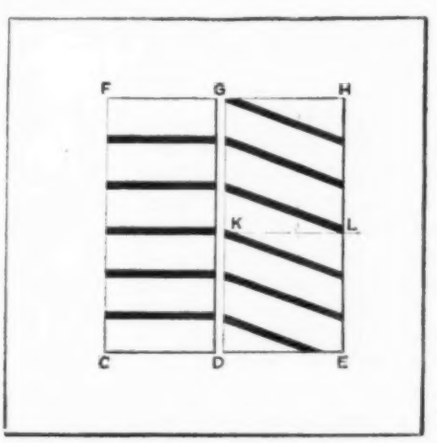
The slope of the two surfaces of B can also be determined by measuring the perpendicular distances between them say at the middle of all four side faces of B by bringing them successively contiguous to A at the point K.

Calibration of End Standards from Line Standards

Having established the fact that two plane surfaces can be brought into contact so that the separation is less than one millionth of an inch, and having the interference method for comparing two gages of nearly equal length, it is possible to calibrate end standards of various sizes from a line standard. The arrangement[10, 11] is shown in Fig. 16. Two gages A and B are brought into close contact, and two fine lines, C and D, are ruled on them parallel to their plane of contact, EF. The distance X between the line C and D is determined by comparison with the line standard. A is then brought into contact with one surface of the long gage G which is to be calibrated, with B with the opposite surface of G.

The distance, Y, between the two lines C and D is again determined by comparison with the line standard. The difference in the two distances $(Y - X)$ gives the length of the gage G in terms of the line standard. With careful work the error in determining the length of G should not be more than 0.00002 in. which is about 0.000003 in. per inch in case G is 6 in. long. After the length of G has been accurately determined by comparison with the line standard or by direct measurement with the light waves, combinations of shorter gages can be compared with it by using the interference comparator as follows. Suppose G is 6 in. long, and we have three gages, A, B, and C, each very nearly 3 in. in length.





FIGS. 14 AND 15. GAGES WITH SURFACES NOT PARALLEL

[10] Fischer, Phil. Soc., Wash., Bulletin, Vol. 13, p. 241; 1898.

[11] Perard, C. R., Vol. 154, p. 1,586; 1912.

G is brought into contact with the plane baseplate W, Fig. 17; B is also placed in contact with W, and A with the upper surface of B. The difference, a, in the lengths of G and the combination of A and B is obtained from the relative displacement of the interference fringes as previously described. The length of A and B is equal to $G + a$. In the same way the b between the combined lengths of $B + C$ and that of G is obtained; likewise c for gages $C + A$.

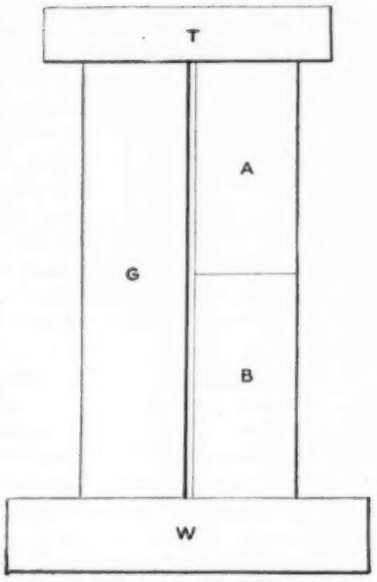


FIG. 17. COMPARING TWO SHORT GAGES WITH ONE LONG GAGE

Letting the designations of the gages also represent their lengths we have

$$A + B = G + a$$
$$B + C = G + b$$
$$C + A = G + c$$

where G is the known length of the standard, and a, b, c, are measured. These equations can be solved readily for the unknowns, A, B, and C. Similarly with four gages, A, B, C, and D, each nearly 2 in. long, we would have

$$A + B + C = G + a$$
$$B + C + D = G + b$$
$$C + D + A = G + c$$
$$D + A + B = G + d$$

Since the four independent simultaneous equations contain four unknowns, the length of each unknown gage can be computed.

In general, given $n + 1$ unknown gages of nearly equal length, n of which when combined are nearly equal to the known gage G, there will be $n + 1$ combinations which may be compared with G; hence, the length of each unknown gage can be obtained by this comparison method. Intermediate sizes may be measured by comparing the combined lengths of a known and the unknown gage with a known.

Comparisons Between Gages and Other Objects

An accurate determination of the dimensions of any body, say a sphere, can be made by comparison with a gage of nearly the same size. For this the gage A and the sphere B are placed in contact with the base plate W, Fig. 18, and the test plate T laid over them. If B is slightly smaller than A, the test plate will touch the gage along the edge E and the sphere at the point C. When illuminated and viewed as shown in Fig. 7, straight fringes parallel to E will be seen to cross the upper surface of the gage. The number of fringes N across the face of the gage from D to E multiplied by $\frac{1}{2}(\lambda)$ gives the distance betwen the cover plate and the gage surface at D. If the distance CE is equal to DE, then the point C must be $\frac{1}{2} N (\lambda)$ below the surface of the gage, and thence the diameter of the sphere $\frac{1}{2} N (\lambda)$ less than the length of the gage. If B is larger than A, the upper plate will touch the gage along the edge D and be $\frac{1}{2} N (\lambda)$ above E. C would then be $\frac{1}{2}\, 2\, N (\lambda)$ above the surface of the gage, and the diameter of B equal to the length of the gage plus $\frac{1}{2}\, 2\, N (\lambda)$.

One uncontrollable factor which changes the length of a gage is wear. The amount that the length decreases from this cause depends of course upon the hardness and use. With the surface of a gage perfectly clean, we have been able to bring it into contact with other clean surfaces several hundred times before the wear amounted to 0.000005 in. If, however, dust or grit is present the wear is greatly increased. We have tested gages that had been used in factories for some time and found they had worn away 0.0001 to 0.0002 in.

Another property which must always be recognized when considering the accurate length of gages is the thermal expansion of the material. A 1-in. steel gage increases in length about 0.000013 in. for every degree C. rise in temperature. The temperature at which the actual length of the gage equals the nominal length must therefore be specified and is usually taken as 20 deg. C. or 68 deg. F. At 25 deg. C. the length of a gage which is one inch at 20 deg. C. is about 1.000065 in. If a gage be measured at the higher temperature its length at 20 deg. C. may be computed if the expansion coefficient is known. If high precision is desired, it is not good policy to use expansion coefficients given in tables because our measurements show that the expansion coefficient of steel may vary from 0.0000105 to 0.0000135 depending on its hardness and composition.

This variation would permit an unknown steel gage that agrees exactly with a standard at 25 deg. C. to differ from it by more than 0.00001 inch at 20 deg. C. If the unknown piece that is being measured is brass or some other material having an expansion coefficient that differs greatly from that of the standard the effect of temperature change is augmented. From these considerations it is evident that to measure or use gages with an accuracy in the millionth place, the coefficient of expansion of the material must be accurately known, and also the temperature controlled and measured to at least 0.1 deg. C.

In Table I is shown the thermal expansion of several

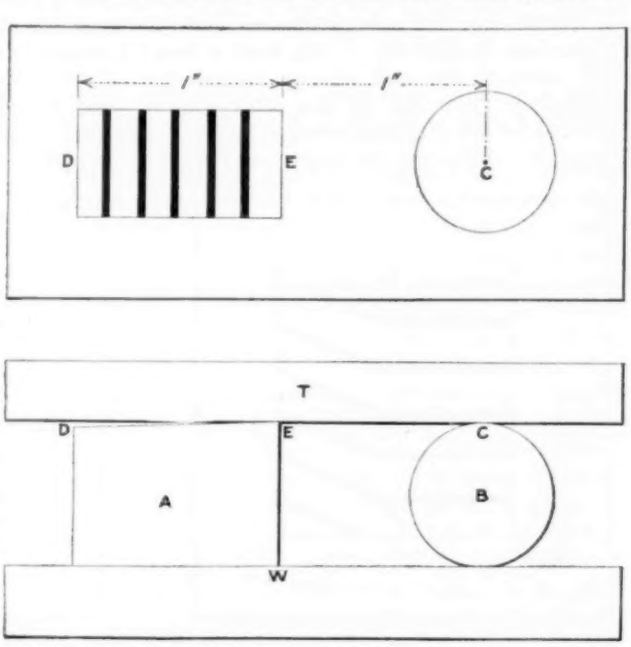


FIG. 18. COMPARING A SPHERE WITH A GAGE BLOCK

TABLE I. THERMAL EXPANSION OF SEVERAL PRECISION GAGES

Gage	Temp. Interval in Degrees C.	Coeff. of Expansion x 10-4
Johansson, Set. 5813, 10 mm	20 to 50	0.129
Johansson, Set. 5813, 10 mm	20 to 50	0.129
Johansson, Set. 5813, 9 mm	20 to 50	0.125
Johansson, Set. 5813, 9 mm	20 to 50	0.125
Johansson, Set 20, 0.4 in	19.8 to 75.5	0.124
Johansson, Set 20, 0.4 in	32.8 to 76.5	0.123
Johansson, Set 7, 0.4 in	56.3 to 79.6	0.131
Johansson, Set 7, 0.4 in	19.6 to 79.6	0.132
Johansson, Set 7, 0.35 in	21.3 to 82.4	0.128
Johansson, Set 7, 0.35 in	20.6 to 82.4	0.127
Bureau of Standards:		
Steel *A*, 0.4 in	24.0 to 76.9	0.132
Steel *B*, 0.4 in	33.0 to 82.8	0.129
Pratt & Whitney, 0.375 in	21 to 78	0.135
Schuchardt and Schutte, 0.5 in	5.8 to 46.0	0.116
Schuchardt and Schutte, 0.5 in	5.8 to 46.0	0.115

TABLE II. VARIATION IN THERMAL EXPANSION OF SOME STEELS FOR DIFFERENT DEGREES OF HARDNESS

Steel	Hardness	Coeff. of Expansion x10-4 20 Deg. to 120 Deg. C
No. 20 C, 0.83 per cent Cr 1.35 per cent	30	0.122
	36	0.123
	90	0.135
No. 21 C 0.98 per cent Cr. 0.48 per cent	40	0.113
	45	0.117
	92	0.131
No. 22 C, 1.18 per cent Cr 0.0 per cent	36	0.110
	43	0.114
	80	0.119
No. 23 C, 0.20 per cent Cr. 14.5 per cent	30	0.103
	38	0.103
	75	0.109
No. 24 C, 1.20 per cent Cr. 16.0 per cent	38	0.103
	50	0.105
	86	0.109

precision gages. These measurements were made with the interferometer and electrical furnace previously described in our publication[12] on the dilatation of optical glass. Column 1 gives the designation of the gage under investigation; column 2 the temperature interval and column 3 the coefficient of expansion.

The composition of steel *B* which is used for precision gages at the Bureau of Standards is C. 1.00 to 1.10 per cent; Mn. 0.30 to 0.40 per cent; P. 0.025 per cent; S. 0.025 per cent; Si. 0.20 to 0.30 per cent; Cr. 1.30 to 1.50 per cent; Balance, Fe. This is almost identical with the compositions that have been published for the steels used in the Johansson and the Pratt & Whitney gages.

Table II shows the variations in thermal expansion of some steels for different degrees of hardness. Column 1 gives the carbon and chromium content, the other constituents being about the same as in steel *B*. Column 2 represents the hardness as measured with the Shore scleroscope. Column 3 gives the coefficient of expansion for the temperature interval 20 deg. to 120 deg. C.

Using steel *B*, expansion specimens were made, hardened and drawn by W. B. Topping and J. F. Draper of the Gage Section. For hardening, the samples were heated to 850 deg. C. and quenched in oil. All showed degree of hardness ranging from 99 to 102 as measured with a scleroscope. They were then heated in oil to different temperatures and allowed to cool in air. Those heated to 149 deg., 176 deg., 204 deg. C. showed no reduction in hardness, while for one heated to 232 deg. C. the hardness was reduced to 97. The thermal expansions of others that were drawn at still higher temperatures are represented by the curves shown in Fig. 19. Degrees centigrade are plotted as abscissæ and per cent increase in the length of the samples as ordinates. The rate of heating and cooling was one degree per minute. Curve 1 represents the expansion of a sample that received no treatment after hardening. It shows a nearly constant rate of expansion between 20 deg. and 225 deg. C.; an increased rate between 225 deg. and 250 deg. C., followed by a much smaller rate between 250 deg. and 380 deg. C. Beyond 380 deg. the rate of expansion increased to about the value found below 225 deg. C. At 450 deg. the heating current was reduced and samples allowed to cool. Its contraction is represented by the straight descending pas of the curve indicated by the arrow point. The original hardness was 100 while after being carried through this temperature cycle the hardness was 76.

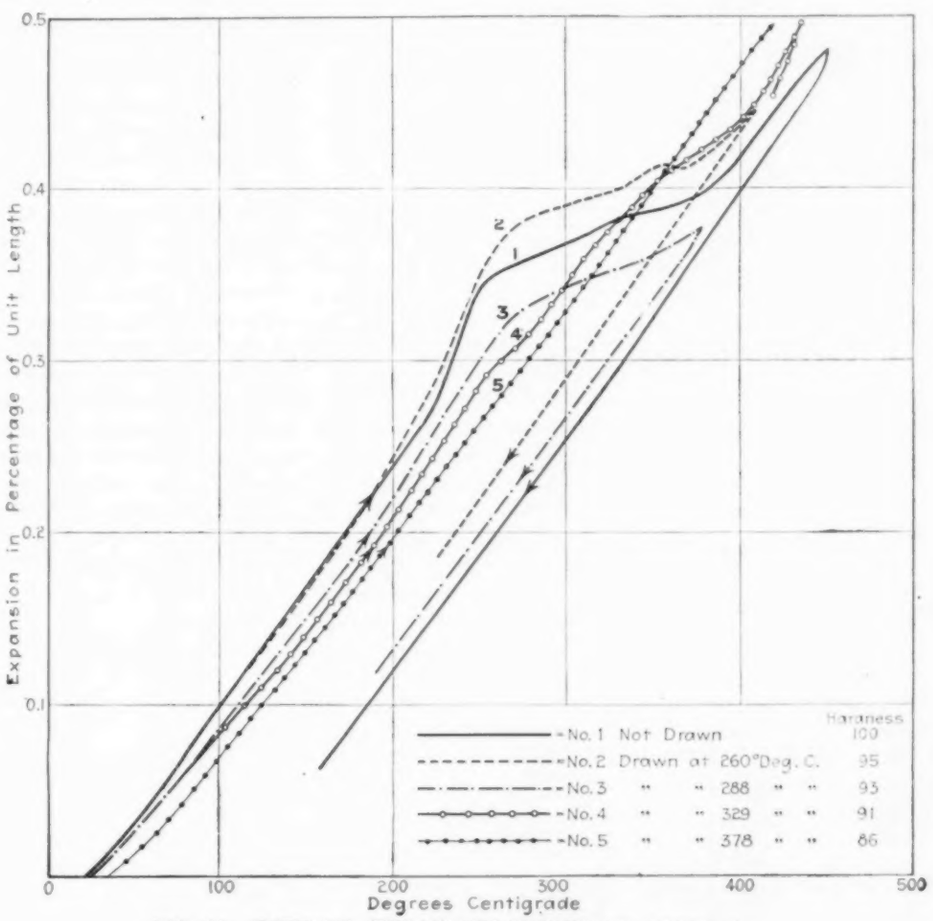


FIG. 19. THERMAL EXPANSION CURVES OF STEEL *B*

[12]Peters and Cragoe, Journal of Optical Society of America, Vol. IV, May, 1920.

Curve 2 shows the expansion of a sample hardened in the same manner and then drawn at 260 deg. C., which reduced the hardness to 95. This curve is very similar to No. 1. It is somewhat straight between 210 deg. and 260 deg. C. At 415 deg. C. the current was reduced and the sample contracted as shown by the descending curve. The hardness of the sample after the experiment was 82.

No. 3, which was drawn at 288 deg. C. had a hardness of 93. The expansion curve does not show the irregularities found in 1 and 2 between 220 deg. and 280 deg. C. but the flat position between 280 deg. and 375 deg. C. is present. The heating was stopped at 375 deg. C. and the sample showed a hardness of 86 on returning to room temperature.

No. 4 was drawn at 329 deg. C. and had a hardness of 91. The curve shows only a slight decrease in the rate of expansion between 340 deg. and 400 deg. C. This sample was taken to 435 deg. C., and showed a hardness of 81 on returning to room temperature.

Curve 5 represents the expansion of the sample that had previously been used to obtain curve 3. In that experiment, it was heated to 375 deg. C. and the final hardness was 86. Curve 5 shows that the sample expanded at a nearly constant rate and that all the irregularities shown by the other curves had been removed by previously heating the sample to 375 deg. C. The heating was continued to 790 deg. C. and on cooling to room temperature the hardness was 34. Between 780 deg. and 790 deg. C. the sample contracted, indicating the transformation point of the steel. The expansion curve above 415 deg. C. is not shown in the figure.

The reduction in the rate of expansion of the samples, represented by the flatter portion of curves 1 to 4 inclusive is probably caused by the strains introduced in the material when it was hardened by sudden cooling in oil from above 800 deg. C. Samples drawn at temperatures below 200 deg. C. showed no appreciable reduction in hardness. Above that temperature the hardness as measured with the scleroscope decreased uniformly as the drawing temperature increased, becoming about 35 for the sample heated to 790 deg. C. The irregularities in the expansion curves decreased with samples drawn at temperatures above 250 deg. C. and disappeared with those drawn at temperatures above 375 deg. C. It seems reasonable to assume that the strains are also removed by heating to 375 deg. C. It would probably be better to say the rearrangement in the material caused by heating to that temperature relieved the strains and removed the irregularities in the thermal expansion. These expansion curves are very similar to the curves we obtained for badly strained glass (loc. cit). With the glass it is possible to watch the strains disappear as the sample is heated through the temperature region in which the expansion rate decreases.

The changes of length of gages with time are doubtless caused by the strains existing in the material. For most purposes these changes are immaterial but in the case of standards they are important. During the past two years we have selected and retained several hundred gages from the products of different manufacturers and measured their length at given intervals of time. Most of these have retained their original length within 0.00001 in. Some, however, have undergone somewhat larger changes, a few examples of which are shown in Table III.

TABLE III. CHANGES OF LENGTH WITH TIME

Gage	Date	Length	Hardness
1.000 in.	3- 1-19	1.000000 in.	98
	6- 3-19	0.999998	
	7-19-19	0.999992	
	8-19-19	0.999992	
	10-16-19	0.999993	
	3-20-20	0.999988	
	5-21-20	0.999988	
1.000 in.	5-21-19	1.000000 in.	98
	5-29-19	1.000018	
	6-17-19	1.000022	
	8-19-19	1.000034	
	10-17-19	1.000038	
	1- 7-20	1.000043	
	3-20-20	1.000044	
	5-22-20	1.000047	
1.000 in.	9-26-19	1.000000 in.	92
	3-20-20	0.999999	
	5-22-20	0.999997	
2.000 in.	3- 1-19	2.000000 in.	96
	5-29-19	1.999976	
	7-19-19	1.999966	
	8-19-19	1.999963	
	10-16-19	1.999951	
	3-18-20	1.999938	
	5-21-20	1.999935	
2.000 in.	9-24-19	2.000000 in.	98
	10-16-19	0.000002	
	1- 9-20	2.000000	
	3-19-20	1.999993	
	5-22-20	1.999992	
3.000 in.	2-20-19	3.000000 in.	90
	4-28-19	2.999975	
	8-20-19	2.999900	
	9-19-19	2.999877	
	3-18-20	2.999856	
	5-21-20	2.999851	
3.00 in.	8-27-19	3.000000 in.	93
	9-18-19	2.999998	
	3-18-20	2.999998	
	5-21-20	2.999999	
4.00 in.	4-29-19	4.000000 in.	94
	6- 2-19	3.999998	
	7-19-19	3.999992	
	8-19-19	3.999980	
	10-16-19	3.999980	
	3-18-20	3.999971	
	5-21-20	3.999970	
4.00 in.	5- 7-19	4.000000 in.	96
	6- 3-19	4.000014	
	8-20-19	4.000025	
	11-26-19	4.000021	
	5-21-20	4.000025	
4.00 in.	12-22-19	4.000000 in.	92
	3-18-20	3.999999	
	5-21-20	3.999993	
4.00 in.	12-27-19	4.000000 in.	93
	3-18-20	3.999998	
	5-21-20	3.999998	

Proof of Strains

To show the existence of the strains a gage was cut as shown in Fig. 20. The gage was originally 0.7 in. long and 0.8 in. in diameter and each end face was four-millionths of an inch convex. The surface hardness measured between 97 and 103. A cut about 0.1 in. deep and 0.04 in. wide was made 0.3 in. from the upper surface with a glass saw. Measurements then showed the upper surface to be 0.00003 in. concave, the lower surface 0.00002 in. concave and the length of the gage to have increased 0.00007 in. On deepening the cut to 0.2 in. the upper surface was found to be 0.00011 in. and the lower surface 0.00006 in. concave. The outer layer must have been under quite a high tension, which was partly relieved

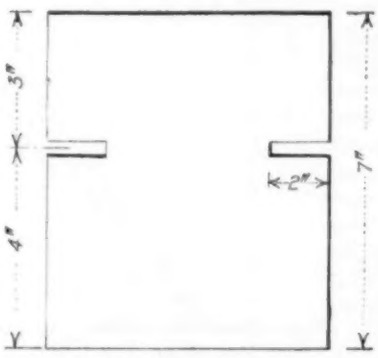


FIG. 20. HOW A GAGE WAS CUT TO SHOW EXISTENCE OF STRAINS

by the saw cut. If this tension is sufficient to cause a flow of the material, the length of the gage will change. It is, therefore, necessary to relieve at least part of the strain in order to make the material permanent. Alternate dipping in ice water and boiling water has been employed to produce that state. Our measurements do not show that any decided benefit is gained from this process. From the results on the thermal expansion just described it seems that more would be gained by heating the gages to 250 deg. or 300 deg. C. This, of course, would reduce the hardness, but if there is any truth in the theory that hardness is due, in part at least, to the strains it would be impossible to relieve any of the strains without reducing the hardness. The range of hardness of most of the gages we have tested is between 90 and 103. A hardness of 93 can be retained after heating to 275 deg. C. It is then a question if any of the resistance to wear resulting from extreme hardness should be sacrificed to obtain the stability of unstrained material.

Conclusions

For commercial gages, such as are used in the shop, the surface errors should not be more than 0.00001 in. since this degree of flatness is necessary to insure good adherence of gages to one another or to test plates. For the uses to which they are put a tolerance of 0.00001 or perhaps 0.00002 in. for gages 1 in. or less in length, and about 0.00001 in. per inch of length for longer ones seems satisfactory. Smaller tolerances are useless because they are soon exceeded by the errors resulting from wear or possibly from changes in the gage due to aging and also because small temperature variations not controlled under service conditions will cause changes of length which exceed the smaller tolerances.

Furthermore, the relative insensitiveness of all mechanical length-measuring instruments as compared with the optical methods makes it impossible to use the higher precision.

There is, on the other hand, no good excuse for larger tolerances than those recommended above because with reasonable care the manufacturers of gages can keep within those limits. For shop use it would appear to be more satisfactory to have available at a lower cost a large number of precision gages which are correct in length within two or three hundred-thousandths of an inch rather than the high-priced gages initially correct within a few millionths. Gages of the highest attainable precision are of value as standards in the testing laboratory.

These should be calibrated by optical methods occasionally since it is known that dimensional changes of material standards occur with wear, temperature and time.

Johnson's Philosophy on Subterfuges and Salesmen

By John R. Godfrey

One of the things that gets old man Johnson's goat is to have anyone try to get by on false pretenses. He doesn't expect perfection but he hates a bluffer and the salesman who tries to put one over on the old man, steers clear for some time thereafter.

I happened to be in the office the other day when a salesman of a war-baby machine tool tried to tell Johnson about his machine. If he'd been content to stick to facts, to saying that it was a good machine and worth the price asked, all might have gone well. But he enthused as per the schedule of the selling talk artist and, in the language of the poet, here's where he spilled the beans.

His whole outfit was almost a Chinese copy of a machine of well-known make. Even that might have been forgiven because Johnson knows from experience that the only way some manufacturers live is by copying other designs. The Johnson motor has been flattered many times in this way. But when the salesman called the machine No. 23, which was the exact designation of the original of this size, he blew up.

"Son" he said "that's a little too much. I can stand your copying my old friend Taylor's machine from stem to stern, for you couldn't copy a better one. But when you calmly appropriate his machine number so as to fool some people into thinking it's the original machine, it's going a bit too far. That number means something to Taylor—it's the third design of his number two machine.

"It doesn't mean a darn thing to your people except to try to fool somebody with. It's mighty near to securing money under false pretenses and I wish there was some way of jailing a few of the fellows who do it. Even if you can't originate a machine, you can at least keep off the real designer's grass plot when it comes to names and numbers. Better get a job with some real people my boy and don't try to sail under false colors."

Some Common Sense Advice on Picking a Salesman

It so happened that Johnson also had another caller that morning, a manufacturer in a somewhat similar line to his own, who wanted to get advice on putting salesmen on the road. He was one of the old timers who thought all the brains were in the office and that salesmen, like office boys, could follow a set schedule day after day and be tied down by a set of rules. He wanted to know what sort of rules Johnson made for his salesmen and how he kept tabs on 'em in general. And he was a bit surprised when Johnson told him about as follows:

"Jones, any salesman who has to have a set of rules isn't worth two hoots in Halifax to you or anyone else. Just remember he isn't a clerk or an errand boy, but that he goes in *your* place because *you* can't spare the time or haven't the nerve or the 'know how.' Your representative wants to be big enough to handle any question that comes up, and no rules can be made to cover all cases.

"You want someone to depend on, not someone who depends on you for orders and rules. If you don't get a man you can trust to do the right thing, don't get any—you can't afford to be represented by anyone who *needs* a set of rules to work by. But don't expect to get anyone who will never make a mistake. Don't forget those you've made yourself. And remember that it's a lot easier to tell a man what he ought to have done after the fracas is all over, than it is to guess right on the spot, with the whole question up to you to decide in a minute or less."

Seems to me we can sort of say Amen to both Johnson's interviews and that they prove him to be a fairly level-headed sort of a man for one of the old school.

The Triple Gear for Ford Transmissions

THE triple gear is one of the main gears in the Ford planetary transmission, three of them being required for each car. The gears were formerly made in three pieces, a central gear with hubs on each side on which the smaller sized gears were pinned. By the new method the gears are all forged in one piece, either on Ajax or National forging machines.

The first machining operation is done on a Bullard Mult-Au-Matic having six working spindles. The operation includes drilling the center hole 0.995 in. in diameter, rough turning the outside diameter, roughing one side, cutting recess for side and hub and finish drilling the 0.995-in. hole. The same machine takes a second cut over the outside diameter, finishes the face and hub, chamfers the corners, finishes one side, finish-bores the hole, finish-turns the outside diameter of the smaller gear which is uppermost, finishes the outside diameter of the larger or center gear to 3.5 in. and chamfers the end of the central hole. These operations are all performed at the rate of 60 pieces per hour. The total requirements being between 11,000 and 12,000 per day, a battery of fifteen machines is required for this work.

The second operation, shown in Fig. 1, is also done on the same type of machine which rough turns the outside diameter of the gear on the other end, cuts the recess on that end, finishes that side and the outside diameter of the other gear. These operations are performed at the rate of 80 pieces per hour.

Next comes the broaching of the hole, after which the teeth are cut in the large or slow gear, as shown in Fig. 2. These machines are Barber-Colman gear hobbers which handle five gears on a single mandrel and finish them at the rate of 13 per hour, requiring 67 machines for the job. The gears are then tested and marked for location and go to a battery of Fellows gear shaping machines as shown in Fig. 3, for roughing and finishing the teeth on the reverse gear which is on one side of the center. This is done in two separate cuts at the rate of 15 gears per hour, requiring quite a battery of machines to secure the necessary production. The primary or low speed gear is cut in the same way, the two cuts requiring five minutes, the production being 12 gears per hour.

After this the gears go to the heat-treating room for hardening and then have all burrs removed from the teeth on Potter & Johnston shaving machines at the rate of 250 per hour.

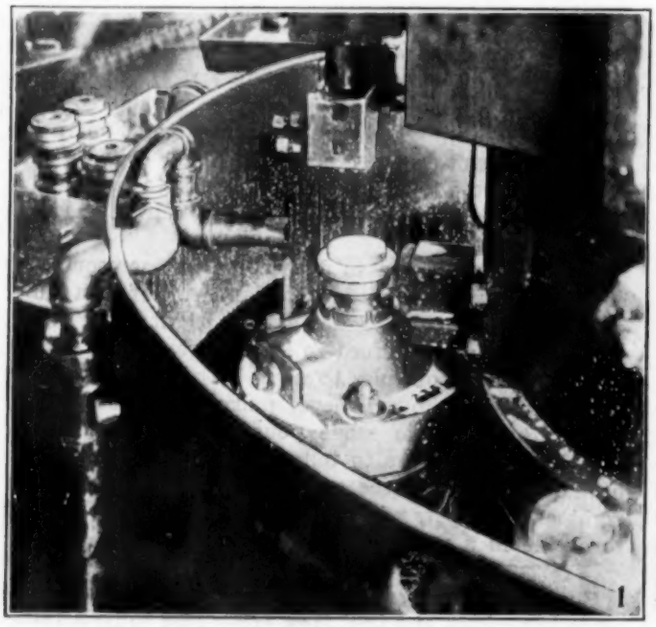


FIG. 1. THE SECOND OPERATION ON MULT-AU-MATICS

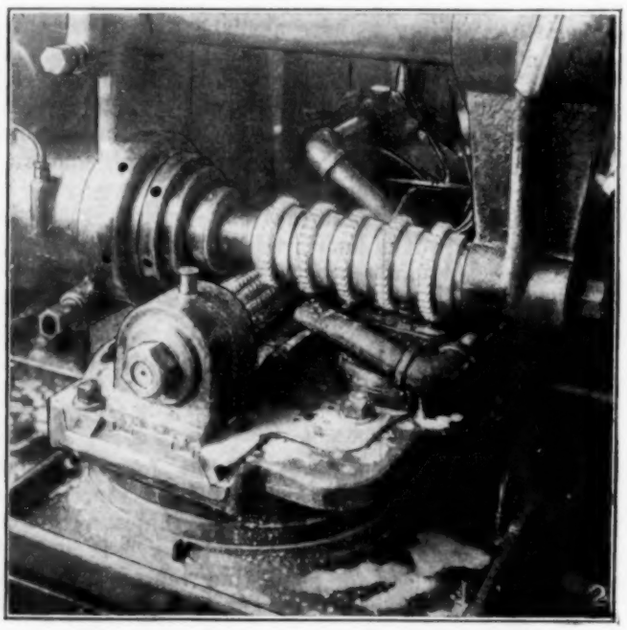


FIG. 2. HOBBING THE LARGE GEARS

AUTOMOTIVE CONSTRUCTION

FIG. 3. CUTTING THE SIDE GEARS ON THE GEAR SHAPER

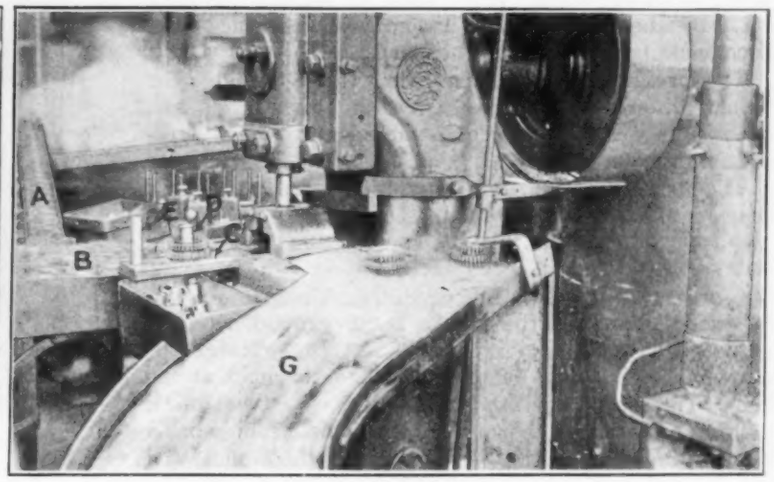


FIG. 4. FORCING THE BRONZE BUSHINGS IN PLACE

The bushings are put in place with a Ferrocute press, as shown in Fig. 4. The chute *A* shows how the gears come to the table *B*, from which the operator picks them and places them in the slide *C*. The bronze bushing is then entered as at *D*, and the slide pushed under the punch by the handle *E*. A single stroke of the ram forces the bushing into place, after which the gears are removed from the slide and placed on the chute *G*, sliding by gravity to the next operation. The spindle of one reaming machine is shown at the right of the chute. This makes very quick handling possible, as can be seen by the production of 750 pieces per hour.

The bushing is then reamed in the Cincinnati drilling machine shown in Fig. 5. Here the gear is placed and centered on plate *A*, which has a vertical movement by means of the handle *B*. When it is forced up into place, guided by the pins *C* and *D*, the reamer finishes the hole, being guided both by the long pilot and the bushing shown at the upper end of the reamer. The guard shown at the left has been removed from the machine to show the operation more clearly. The gears are handled at the rate of 350 per hour. Spot facing the bushing finishes the operations on this gear.

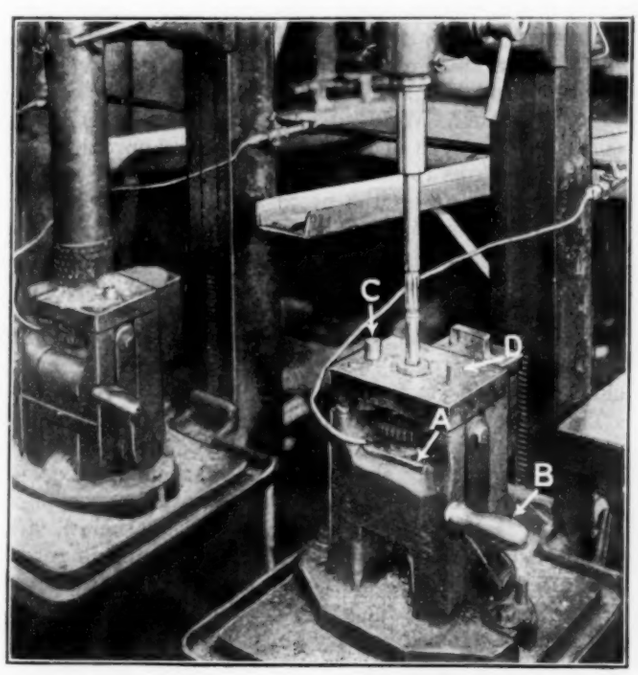


FIG. 5. REAMING THE BRONZE BUSHINGS

Machining Change Gears

BY DOUGLAS T. HAMILTON

A simple part, such as a change gear, would seem hardly worth looking at from the production standpoint; but when several thousand of such parts must be turned out every month, a few minutes saving on each one, makes a study of the problem worth while. On the Fellows gear shaper, the change gears range from 1⅜ to 9¼ in. in diameter. Up to 3 in. in diameter they are made from bar stock; whereas from this size up they are made from iron castings, the smaller sizes being solid blanks, and the larger sizes cast with arms.

The former method of machining was to turn the

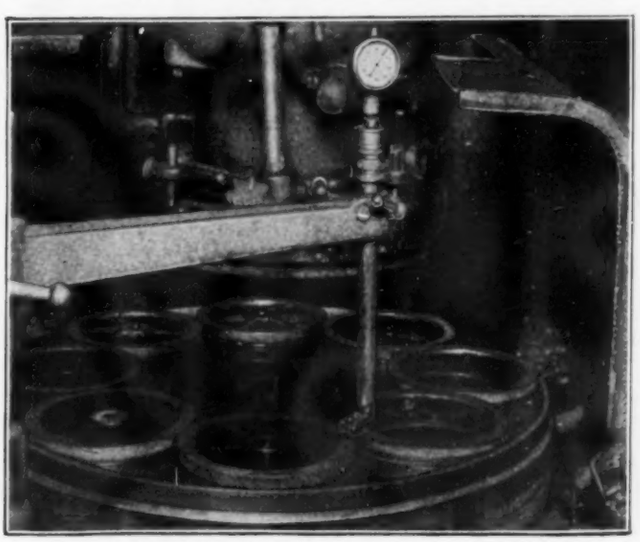


FIG. 1. SURFACING GEAR BLANKS TO THICKNESS

outside diameter, drill, bore and face one side in a turret lathe. Then the blank was reversed and the other side and hub faced in another turret lathe. The keyway was then cut with a hand-operated key-seating tool, after which the blanks were ready for having the teeth cut. By these methods, one blank was machined at a time, making production rather low.

The present method of maching these change gear blanks differs considerably from the former method, both as regards methods of handling and from a production standpoint.

The first operation, which is illustrated in Fig. 1, consists in facing the rough castings on a Blanchard surface grinding machine. The castings are made with $\frac{1}{32}$ in. excess stock on each side, and this amount is removed by grinding. The production time is governed by the diameter of the blanks being ground, as it is evident that the smaller the blanks the greater the number which can be held on the magnetic chuck at one time. The second operation is handled on a two-spindle drilling machine, as shown in Fig. 2. This machine has a special indexing fixture clamped to the table and arranged to carry three universal three-jaw chucks. The first spindle drills the hole, and the second one finishes it with a reamer. It will be noted in the illustration that two arms are attached to the column of the drilling machine that carry guiding bushings for the drill and reamer, respectively.

The drilling machine is provided with power feed, so that the operator's hands are free to load and unload the chucks, and index the fixture. The third chuck is provided, so that while one blank is being drilled and the other reamed, the third chuck can be unloaded and loaded, making the machining practically continuous.

Following this the keyway is cut in a key-seating machine, after which the blanks are taken to the Fay lathe, shown in Fig. 3, where the outside diameters are turned to size and the corners rounded. Four blanks, as shown in Fig. 3, are held on an arbor, and are completed at one setting. The large range of sizes is

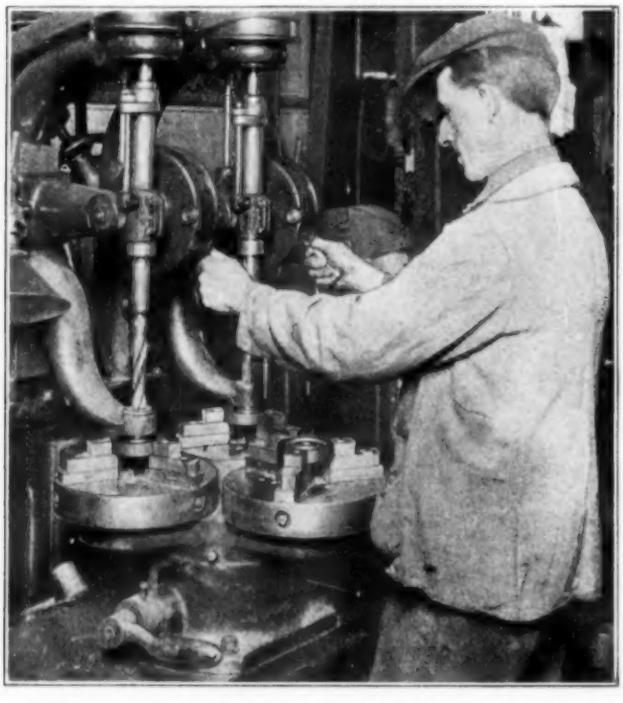


FIG. 2. DRILLING AND REAMING HOLES IN GEAR BLANKS

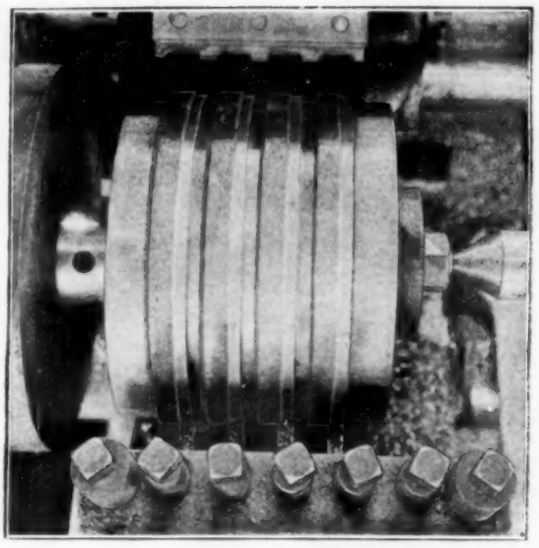


FIG. 3. TURNING AND CHAMFERING GEAR BLANKS ON A FAY LATHE

easily handled in this lathe by using interchangeable arbors. The only change for each size being the resetting of the tools. Four tools are used for turning the outside diameter so that the length of travel is equal to the face width of one gear blank. Four gang tools that are fed straight into chamfer the corners on the four blanks.

The next operation, not illustrated, is cutting the teeth, which are of 16 pitch. This operation is handled on a Fellows spur gear shaper. The average time per change gear, complete, is five minutes.

Built Up Adjustable Angle Plate for Light Drilling

By W. Burr Bennett

On page 279 of *American Machinist*, H. H. Parker describes a device with the above title. In a purely constructive spirit of criticism the writer would like to make some suggestions.

First of all, apart from the design, does it pay to build this kind of a tool from small pieces; assuming of course that any such fixture is built to use and not for amusement? We long ago found out in our toolroom that this type of construction costs approximately twice as much as to make a pattern, get a good casting and then machine up the necessary surfaces.

Secondly, this built up construction is never free from coming apart and losing its alignment. Take the pivot plate in this design for example; even with dowels, which are not shown, it will loosen under the wear and tear of use and spoil the alignment. Ears cast solid with the angle plate would be far cheaper to build and would be permanent.

This same criticism would hold good for the top plate, the angles that hold the rocking column, and the bearings for the rocking shaft. Finally, how is the locknut on the adjusting screw manipulated when assembled and what is to insure the taper pin always being with the angle plate when needed? We have found in reference to this point that all loose pieces must be attached with a chain. Admittedly the functional design of this tool is good. It can be used through 90 deg. and would prove to be a handy device but the writer has learned that the above points of criticism are quite relevant.

Figuring Diameter of Three-Surface Tangent Plug

By Francis W. Shaw

The tangent-plug problem seems to have occasioned considerable trouble, even in its more simple form. The case where two of the three surfaces to be gaged were at right angles was treated on page 1098 of Vol. 50, page 914 of Vol. 51 and on page 148, Vol. 52, of the *American Machinist*. The toolmaker is just as likely to meet a problem where the angle at *A* in the sketch is greater or less than 90 deg., hence a consideration of the problem from the broader aspect will, it is thought, be worth the space it will occupy.

The original problem is a particular case of the escribed circle of a triangle *ABC*, referring to the accompanying figure. Let *r* be the radius of the escribed circle to be determined, and *abc* the sides of the triangle opposite respectively to the angles *ABC*.

Bisect the exterior angles at *B* and *C* by *BO* and *CO*. These lines will intersect at *O*, which can be readily shown, as follows, to be the center of the required circle. Draw *OD*, *OE* and *OF* perpendicular to the sides of the triangle *ABC*, extended if necessary. Now the angles *ABC* and *DBC* are together equal to two right angles. Therefore, the angle *DBC* is equal to two right angles minus the angle *ABC*, or *B*. Half the angle *DBC*, therefore, is equal to one right angle minus half the angle *B*. That is:

$$\text{angle } OBF = 90^\circ - \frac{B}{2}$$

Similarly, it can be shown that

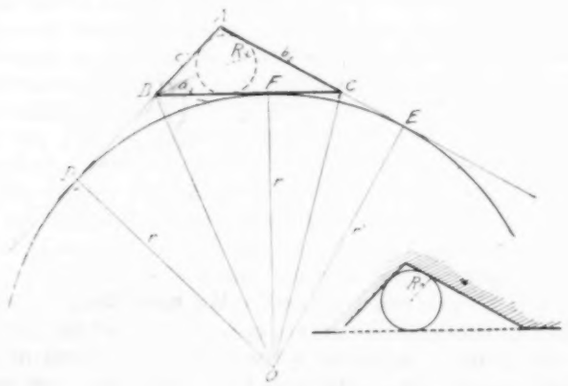


DIAGRAM SHOWING GENERAL CASE OF THE THREE-SURFACE TANGENT PLUG PROBLEM

$$\text{angle } OCF = 90^\circ - \frac{C}{2},$$

from which it follows that

$$BF = r \cot\left(90^\circ - \frac{B}{2}\right) = r \tan \frac{B}{2},$$

and that

$$CF = r \cot\left(90^\circ - \frac{C}{2}\right) = r \tan \frac{C}{2}$$

But, $BF + CF = a$. Therefore,

$$r \tan \frac{B}{2} + r \tan \frac{C}{2} = r\left(\tan \frac{B}{2} + \tan \frac{C}{2}\right) = a$$

This formula rearranged, becomes

$$r = \frac{a}{\tan \frac{B}{2} + \tan \frac{C}{2}} \qquad (1)$$

Where *A* is a right-angle the above can be rewritten:

$$r = \frac{a}{\tan \frac{90 - C}{2} + \tan \frac{C}{2}}$$

or,

$$r = \frac{a}{\tan \frac{B}{2} + \tan \frac{90 - B}{2}}$$

It can also be shown that

$$r = \frac{a \cos \frac{B}{2} \cos \frac{C}{2}}{\cos \frac{A}{2}}$$

For the inscribed circle shown dotted it can be demonstrated that:

$$R = \frac{a}{\cot \frac{B}{2} + \cot \frac{C}{2}} \qquad (2)$$

The relation between the inscribed and escribed circles can therefore be expressed by:

$$\frac{r}{R} = \frac{\cot \frac{B}{2} + \cot \frac{C}{2}}{\tan \frac{B}{2} + \tan \frac{C}{2}} = \cot \frac{B}{2} \cot \frac{C}{2}$$

For those who do not follow the above identity a numerical example will be given, it being remembered that the cotangent is the reciprocal of the tangent. Let $\cot \frac{B}{2} = 2$ and $\cot \frac{C}{2} = 3$; then

$$\frac{\cot\frac{B}{2}+\cot\frac{C}{2}}{\tan\frac{B}{2}+\tan\frac{C}{2}}=\frac{2+3}{1/2+1/3}=\frac{5}{5/6}=\frac{5\times6}{5}=6=2\times3$$

$$=\cot\frac{B}{2}\cot\frac{C}{2}=\frac{r}{R}.$$

The small sketch on the right illustrates the use of the formula for the inscribed circle. The angles would be checked with angle gages and the depth with a wire of the size calculated by formula (2).

Making Spherical-Ended Length Rods

By William Older

Quite a number of spherical-ended measuring rods were recently required in a certain shop. They varied in length from a little over 1 in. up to about 25 inches. There was nothing very accurate about them, a tolerance of a couple of thousandths being allowed.

The first lot of six was made by a young mechanic on the engine lathe, and they were a nice job; but after they came from the hardening practically as much time had to be spent on bringing them to length as had already been put on making them. When the next lot was required it was suggested to make the bodies of the rods of cold rolled, have their over-all lengths shorter than called for, turn the ends square, and force a steel ball into a hole in each end for a contact point.

To fit the steel balls, the rod was held in a collet in a bench lathe and holes drilled in the ends one or two thousandths smaller than the diameter of the ball which was to be forced in. The first hole was drilled, with an ordinary twist drill, sharpened in the usual way, to a depth equal to about five-eighth or two-thirds the diameter of the ball. The ball was then driven in with a brass hammer until it struck the bottom of the hole. The distance from the ball end to the flat end of the bar was then measured and thus it was easy to figure how deep the hole should be drilled in the other end for the second ball. The rod was again held in the collet of the bench lathe, and the hole was drilled first with an ordinary drill, and then brought to depth with a drill ground so that it would leave the bottom of the hole flat. The second ball was forced in with the aid of the brass hammer.

Some of the rods were too short and some too long. The short ones were peened to length while those which were too long were bent slightly to bring them to size. This type of rod is shown at *A* in the accompanying illustration. If the hole is drilled very slightly smaller than the ball, the balls will be held much more firmly than if the hole is made so small that the rod is badly stressed when the ball is driven in.

Removable Balls

Since making these rods we have used the same method to apply ball contact points in multiplying levers for some experimental measuring devices.

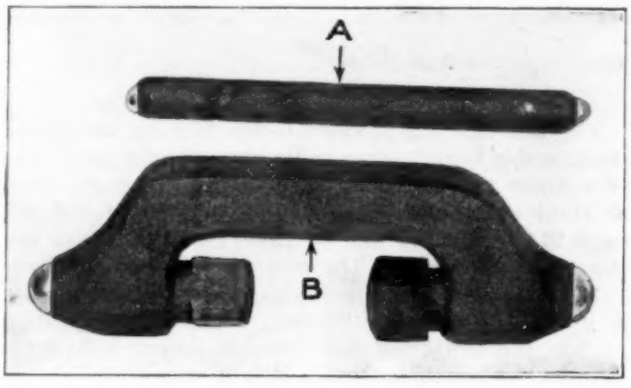
Where it seems desirable to secure the balls so that they may be removed, the holes can be drilled large enough for the ball to enter and seat. They can then be soft soldered in place, the melting point of soft solder being so low that the temper of the balls is not drawn during the soldering process.

Another method of securing ease of removal is to slit the end of the rods after the holes for the balls have been drilled. This permits a narrow wedge to be entered under the ball so as to drift it out. When this method of fastening is used one must not saw the slot beyond the bottom of the drilled hole as the ball will sink slightly into the slot, which results in a shorter distance between the balls than where the flat bottom of the hole is used as a seat.

A peculiar illusion was noted with these ball-ended rods. If the tip of the finger is rubbed over a ball which is tight in the end of a rod one experiences the sensation that the ball is loose enough to roll in the hole.

Adjustable Ball Seats

The making of these measuring rods is not quite as easy as it seems to be from a mere description, and the difficulties encountered resulted in the development of



TWO TYPES OF BALL-ENDED MEASURING RODS

the gage shown at *B*. The rods we use are forgings, but there is no reason why castings should not be used if there are enough of a size required. Malleable castings would, of course, be preferable to gray-iron castings where it is desired to secure the ball by soldering it in place.

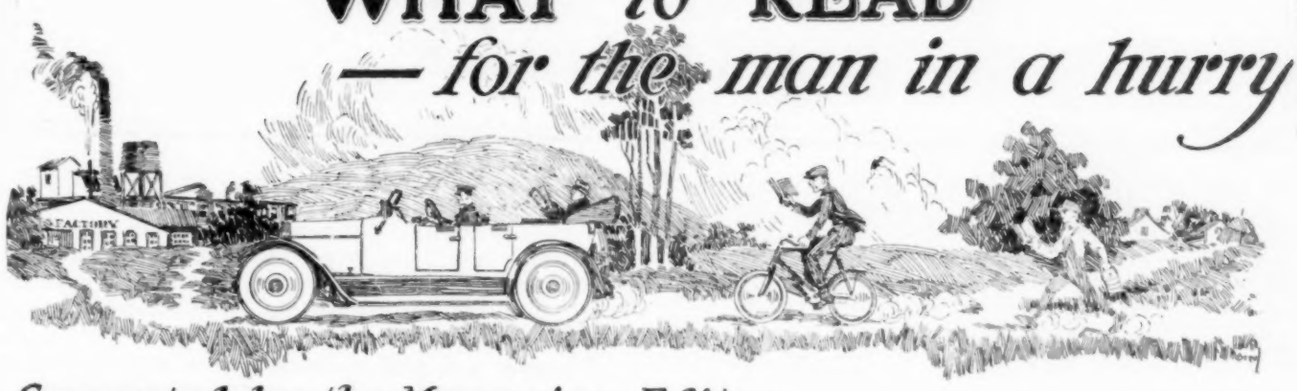
The holes for the balls are drilled "between centers" in a lathe. The ends are then turned to the desired size and taper, after which the hole is widened on the inside with a special counterbore, so that when it is tapped the ball seat will be smaller than the threaded part of the hole.

The tap used should have a fine thread; and we used 20 threads per inch as it facilitates setting the ball, one turn advancing it fifty-thousandths.

The tap is also special, although we have used commercial fine-thread taps by grinding them so that they cut with the "heel" of the land. The shanks of the taps must be small enough and long enough to pass through the small part of the hole which is to act as a seat for the ball. The shank of the tap is passed from the inside through the hole and acts as a pilot while the hole is being tapped. The tapped hole should not go beyond say five-eighths of the diameter of the ball from the end of the body. In other words, the length of the hole which is to act as a seat for the ball must be at least five-eighths of the diameter of the ball, and if it is less in length than one-half the diameter of the ball there is a chance of forcing the ball entirely out of the hole by means of the screw.

When one is rigged up for making this type of measuring rod and has made a few of them the operations are very simple and can be carried through very quickly.

WHAT *to* READ
—for the man in a hurry



Suggested by the Managing Editor

WE HAVE run several very instructive articles on deep hole boring in this magazine from time to time but never anything to compare with the story that has the position of honor this week. Why? Because the holes discussed this time are anywhere between a quarter and one-half mile long. In cast iron? No, in sand, mud and hard rock through which the outdoor mechanics of the oil fields have to drill before they reach the oil pool below. And the discouraging part of it is that quite often there is no oil there when they get down to where it ought to be. But read Fred Colvin's story of the oil field mechanics; it gives an interesting picture of ingenuity in the face of obstacles. On page 657 we have the second article in J. V. L. Morris' series on "Programs of Apprenticeship." The system described this time is the one in vogue at the plant of R. Hoe & Co., manufacturers of printing presses. The Hoe plan is no innovation as it has been in successful operation since 1872 and represents an adaptation of the old-fashioned apprentice system modified to meet modern conditions. It should be particularly valuable to managers considering apprenticeship problems because of its proved worth.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

The next article, page 660, gives the machine designers something to think about. It concerns the design of a merchant mill flywheel and is by Captain J. B. Varela of the Coast Artillery. Flywheels have an unfortunate habit of flying into small pieces when wrongly designed or handled and consequently any contributions to the subject of their design should be welcome.

This week's welding article appears on page 665 and takes up the details of arc welding procedure. The illustrations show the best methods of welding all kinds of joints and the text follows them with clear and concise instructions and warnings against unnecessary or harmful steps which are sometimes taken through ignorance. In addition Mr. Viall gives figures on welding costs and suggestions on the design of welded joints. Taking it altogether we think that this is one of the most valuable parts of the whole series.

Something more on the lowly apprentice appears on page 671. Here Mr. Colvin has a few words to say about the way Brown & Sharpe treats its boys outside of the shop. This matter of keeping track of a student outside of school hours is most important, it seems to us, and there is no apparent reason why a little judicious supervision of his loafing and recreation time should not be as good for an apprentice as it is for a college boy.

The second and concluding installment of the Bureau of Standards article on the calibration of precision gage blocks by Peters and Boyd starts on page 674. We have studied this article with a good deal of care and we have learned a lot from it. While the methods and apparatus employed undoubtedly have little value in a machine shop, there is a good deal of satisfaction in knowing just how and why this exceedingly accurate calibrating is done. The authors conclude with some very sensible recommendations which show that their sense of the fitness of things has been well developed.

A little philosophy on salesmen by our old friend Godfrey follows the gage article, page 679. Read it and see if he isn't about right, as usual.

Our automotive article this time has to do with gears, in particular some of those used by Mr. Ford in his famous "noiseless" transmission. Following this article by Colvin is another on gears by Douglas Hamilton of the Fellows Gear Shaper Co. It tells of a high production gear job where several short cuts saved time in the preparation of the blanks for the actual cutting of the teeth.

Again this week we are forced to devote considerable space to the description of new tools. Some of course should have gone in last week but we simply didn't have room for them and they had to wait over. If the rush keeps up at the present rate we will have to put on more pages, and with paper where it is now—well, we'd just as soon not do it.

Before we close, one word more about apprentices, even at the risk of overdoing it. Entropy has some comments on trade school education on page 691 that are well up to his usual standard.

EDITORIALS

Cincinnati Strike Won By Employers

ACCORDING to information which we have received the machinists' strike in Cincinnati, which involved over 100 plants and about 7,000 men, has been called off, the men voting to return to work.

This strike has been in progress about five months and has resulted in the loss of millions of dollars in wages and business.

The men are now returning under the identical open-shop and other conditions prevailing at the time the strike was called. Employers are also requiring that the men who return and are accepted must work at least three weeks in the plant from which they struck before they will be considered for acceptance as an employee by any other company.

Every plant originally affected by the strike is in operation, some at full capacity, and figures compiled by the employers show there are only about 300 machinists remaining out, and they are mostly men for whom there are no vacancies.

The International Association of Machinists assessed its 350,000 members each $1 per month for the first six months of this year. This fund was intended for use in unionizing the entire industry and Cincinnati was chosen as the ground on which to begin the battle. The National Metal Trades Association stepped in and protected the Cincinnati manufacturers by assuming entire charge of handling the strike. Thus it became squarely an issue between the N. M. T. A. and the I. A. of M. as to whether Cincinnati was to remain open-shop in the metal trades, or be forced to unionize.

A phase of the situation not ordinarily encountered was the fact that several members of the committee which signed the original demands on the employers were known members of the Communist party, so in certain respects the employers' victory is not merely one for the open-shop, but for Americanism against Bolshevism. E. V.

For the Good of the Industry

IN THESE days, when changes are in the air, whether they appear on the surface in our immediate neighborhood or not, it is wise to look beyond the details of our individual businesses to the broader problems of the industry as a whole. The machine-building industry stands at the forefront of civilization as we know it. Its importance gives it not only advantages and privileges, but duties and responsibilities as well. And these should be considered by all in determining the policies of their business.

The old idea of absolute individuality and independence no longer holds. Associations of business men, such as the National Machine Tool Builders' Association, have long proved the necessity and the advantage of collective action. In the same way we are coming to realize that the consumer or the public has an interest in the proper and progressive conduct of all business. All management which considers the future, and this should include all but fly-by-night concerns which are a serious detriment to any industry, must look beyond its immediate business and consider the industry as a whole. Individual advantages and practices which reflect on the good name of the industry as a whole tend to invite disaster, as they invoke the wrath of a not too discriminating public and lead to legislation which is not always wise.

Whenever annoying problems arise, and this is all too frequent, there is a tendency to act hastily and give decisions which, instead of settling the difficulty, only fan the flame. While we are none of us angelic, and the wisdom of Solomon is not a common commodity in these trying days, it may help a little if we try to consider the effect on the industry as a whole, instead of confining our attention to our own plant. If we stop to think how a decision or a policy would affect us if adopted by others, of how it may affect other manufacturers in our lines either directly or through adverse legislation which may come from public resentment, it may help in deciding wisely for all. F. H. C

The Awakening of the Engineer

SIGNS are multiplying that the engineers of the country are beginning to wake up to a new sense of their importance and responsibility as a profession. The vast majority of them have always been awake to their individual responsibilities and their devotion to duty has been exemplary.

The Federated American Engineering Societies represents a movement in the right direction in which we firmly believe, and concerning which we have had a good deal to say. Such a federation has been talked of many times in the past but in no case was it possible to interest more than a very few members of the profession. The time was not ripe, for the average engineer was so engrossed in his own affairs that he did not realize the importance of co-operation with other engineers, to the profession and to the community.

The federation plan looms large among the big progressive movements of the day. Not only will the engineer come into his own, but the country as a whole will benefit by his wisdom, skill and trained initiative when he is drawn from his seclusion to an active part in our national life.

But this is not the only significant occurrence. Another plan is afoot. Briefly, it contemplates the introduction of courses in industrial management in a majority of our colleges, the placing of students and teachers in summer jobs in various industries and the reaching of men already engaged in management work through extension courses. The scheme is backed by corporations capitalized at more than twenty-five billion dollars and the control is vested in a council composed of representatives of the corporations and of the colleges and universities interested.

Most of the educators back of the movement served in the Council of National Defense and were aroused to the value of continuing the co-ordination secured by that organization. The approval of the idea by engineer-

ing teachers indicates an awakening on their part to the necessity of providing better contact with practical matters for engineering students before graduation.

On the other side, the cordial reception of the scheme by industrial concerns shows their appreciation of the need for properly trained engineers to fill executive positions, and their belief in the efficacy of making a start along this line before the man leaves college. We heartily favor the plan as outlined in a news item on another page and we look forward with a good deal of optimism to its effect on the future welfare of the engineer and the community.

Either of these movements would probably have failed dismally if they had been attempted ten years ago. That they have been received with so much favor now indicates clearly that engineers are at last awake and are going ahead to new service and power.

K. H. C.

The Federated American Engineering Societies Will Help

UNDER the caption "Have We a Representative Government?" the *Canadian Chemical Journal* prints the following:

Imagine some of our chemical friends or engineering colleagues entrusted with the framing of a bill to present to the Imperial Parliament having in view the establishment of a court of last resort in the Dominions to replace the Privy Council, or an act to revise the proceedings in chancery.

Our representative (?) system of government has resulted in a situation wherein lawyers, country doctors and farmers are called upon to legislate upon the details of forest protection, water pollution, railroad operation, food conservation, the development of mines and technical education.

Is it not time that our agrario-medico-legal friends had some technical colleagues at Ottawa and the Provincial Capitals? No group of men is better prepared to discuss these subjects in a disinterested way, or better equipped for the discussion, than chemists or engineers.

The question may well be asked whether a representation that is geographical and based on population only, is really representative.

Would not a chemist from Winnipeg or Halifax be more representative of the chemists of any part of Canada than a farmer, lawyer or labor leader from their home town?

Let us have chemists in Parliament and let our engineering friends have engineers in Parliament. "Even though they be voices in the wilderness," let's have a voice!

It seems that our northern neighbors have much the same trouble that we have—their government is representative in a sense, but not in the fullest and best sense. Wild lands, such as theirs and ours were, have been conquered, put to work and made to support great numbers of people, by the explorer, the settler and the engineer. Then the running of them has been turned over to the "lawyer, the country doctor and the farmer."

We need lawyers and we need farmers in the legislative branch of our government and it doesn't hurt to have an occasional country doctor. But so much of our legislation is directly concerned with things technical and there is required so much legislation to bring about conservation of our national resources, that we also need engineers—in the legislative branch and in the executive branch as well.

There are many engineers in the United States and they all realize the truth of these assertions. They have been working toward the goal suggested for many years, but in a small way only, because they had no strength—no organization. If all the engineers in the country could get together, agree on what ought to be done concerning things technical which affect the welfare of the country and then use their united efforts to get those things done, they could accomplish wonders.

The first several steps toward getting all engineers together have been taken, resulting in the formation of the Federated American Engineering Societies, an organization with membership made up of existing engineering and allied technical societies. The Federation is to be managed by a body known as the American Engineering Council, consisting of representatives of member-societies. Member-societies may be national, local, state or regional, thus insuring an organization truly representative which will then have the voice of a large number of the engineers of the country as regards matters of public welfare where technical knowledge and engineering experience are involved.

The F. A. E. S. was organized in Washington, D. C., on June 3 and 4. The American Engineering Council, its managing body, will hold its first meeting Nov. 18, 19 and 20 in Washington. We urge that such of the 171 societies represented at the organization meeting, as have not done so, make application for membership to the society, so that they may have their representatives on American Engineering Council when it meets Nov. 18 at the New Willard Hotel, in Washington. Engineers are to be awakened in regard to their own capabilities and the public is to be awakened as to the value of the engineer. These awakenings had better be begun in November, 1920, than in November, 1921, when the next annual meeting of the Council will be held. The time between now and Nov. 18 is short but it should be sufficient for member-society action.

L. C. M.

We Agree With Gompers!

IT IS not often that we can whole-heartedly agree with what Mr. Gompers says or does, but this time he has shown himself a real level-headed American, and we are with him.

In a statement in the last issue of the *American Federation*, which is signed by Samuel Gompers, president, and Mathew Wohl, vice president, of the American Federation of Labor, the American body repudiates the labor movement of Great Britain, declares utter lack of sympathy with policies announced by the International Federation of Trades' Unions, which met last month in Amsterdam, and declares against the Soviet movement of Russia.

Of course Mr. Gompers' statement was authorized by a vote of the labor body of which he is president, but to him is largely due the credit.

Repudiation of British labor and of the international organization is based on the refusal of American labor to join in a socialistic movement which aims to support the Soviet system of Russia and is urging support of revolutionary activities. Sovietism and all that the Russian movement means is utterly condemned.

Mr. Gompers recognizes the fact that the ballot in America offers the opportunity for any desirable changes of government. He says:

"But it (America) is a republic based upon the principle of freedom, justice and universal suffrage. Our men and our women are not likely to throw these rights and principles into the scrap heap for the dictatorship of Moscow's Lenine and Trotzky."

Industrial America owes much to Mr. Gompers for his sane and AMERICAN stand on this issue. E. V.

What Other Editors Think

The Gospel of Work

By H. H. Southgate
Advertising Manager, the United States Motor Truck Co.

IS AMERICA to become a nation of shirkers and slackers? Shall we continue to "let George do it"? Or are we now ready to emerge from the mental slump which followed the World War and jump aggressively into the world-wide battle of commerce?

Our place is among the leaders of the earth in commerce, finance and industry. But unless we come out of our trance, that place will be forever lost to us. America today plays the part of the dissolute Nero, jazzing away the precious hours while the Rome of our opportunity is destroyed by the fires of indifference.

"George"—meaning both our friends and enemies among the nations—is doing it, alright. He is going full speed ahead. Instead of leading, we are trailing. And lack of production is wholly responsible.

Work pays the bills. Work earns promotion. Work—honest, hard work—will help bring down the high cost of everything. Nothing else will.

We idle. We talk. We play. Others work. They toil night and day to repair the ravages of war, and to build up production in all lines.

What is the answer to be? Will America work, or will she want? Is the high cost to decrease, or will idle plants and empty shelves force it still higher?

The man who works fewer hours or does less work hurts his own cause. He cuts down production. He is an industrial SLACKER. There is no more excuse for his conduct than there was in war times for the man who evaded his war obligations. Not alone does he injure himself. He hurts his family—his friends—his country.

Our safety as a nation depends upon PRODUCTION—hard, driving effort to forge ahead. Before the war, and during it, we made wonderful progress through production. Then we stopped to rest. Our minds and bodies are now rested and refreshed. Once more we must work—work to LIVE.

PRODUCTION means work—WORK—and still more work!—until each of us has reached the height of his efficiency and earning power. Not alone do we need production in the factory, but in the office, on the road, on the farm, in the home—in every phase of our lives.

Work for the joy of the work itself—for the sake of successful accomplishment—for the betterment of all—to bring down the high cost of living through increased production and decreased overhead—for the future peace and comfort of our sons and daughters—for the salvation of America—WORK!

Talk will not right conditions. Act! Work more and talk less. And as production creeps higher, day by day, the difference in prices and conditions will become apparent. PRODUCTION alone will make that difference. Work brings production. Preach the Gospel of Work.—*An editorial from the U. S. Floating Power Plant News.*

A Discredited Government Report

From the *New York Sun*

AN INSTANCE of the superficial and unreliable character of economic investigation under the present Administration is to be found in the critical study of the United States Public Health Service's Bulletin No. 106 that has been made by the National Industrial Conference Board, an organization representing twenty-nine large industrial organizations.

The Public Health Service bulletin purported to be an authoritative study of the comparative results obtained in an industrial plant with an eight-hour day and in one where the ten-hour day was the standard, the conclusion reached in the Government report being that "a comparison of the eight-hour and ten-hour systems leads to the conclusion that the eight-hour system is the more efficient." Specifically the report states:

(1) The outstanding feature of the eight-hour system is steady maintenance of output; (2) under the eight-hour system work with almost full power begins and ends approximately on schedule and lost time is reduced to a minimum; (3) under the ten-hour system artificial limitation of output is widely prevalent. Under the eight-hour system output varies more nearly according to individual capacity.

When submitted to the acid test of fact by the National Industrial Conference Board it was shown that "the two plants from which the data were obtained are not fairly comparable and the basis of experience is too small to justify comprehensive conclusions."

The Government bulletin compared a thoroughly established and highly efficient manufactory of automobiles, running on an eight-hour schedule, with a rapidly expanding munition plant operating with a hastily recruited labor force. The eight-hour plant was slightly reducing its labor force during the year under investigation, while the ten-hour plant had more than doubled its force. The number of women in the eight-hour plant was only about one per cent of the entire force, while in the ten-hour plant it was twenty-five per cent of the whole; and the operations studied at the eight-hour plant were the characteristic processes of an automobile factory, to which the personnel were thoroughly accustomed, while the operations studied at the ten-hour plant were the novel ones of making brass fuses for shells.

The report of the National Conference Board points out that "the official sanction behind the publication of these conclusions gives them a special prestige in the minds of many people," and adds:

It is always against public interest for unwarranted and unscientific statements relating to any important problem to be given publicity, whatever the source may be. In these days of industrial unrest it is especially unfortunate if that source is an agency of the Government. Such is the condemnation that can justly be leveled against Public Health Bulletin No. 106.

This indictment is all the more effective from the fact that the Conference Board some months ago issued a study of its own on this subject with the statement

that the facts reported were not conclusive as to industry. The number of working hours which economy, efficiency and the welfare of the worker meet to mutual advantage cannot be arrived at from the experience of a single factory or a single industry. Each plant usually must discover for itself. The employees of a Western factory recently proved to their employers, in a test lasting six months, that they could do as much in nine hours as in ten. The employers gladly lowered the hours. This is the practical and safe way.

Calculation of Loads on Bearings

By John S. Watts

There seems to be a certain degree of carelessness among designers in fixing the size of bearings, not so much in the standard machines made in quantities, as in the special machines for mining and constructional work, where only one machine is made from each design.

A common practice seems to be to make the shaft large enough to carry the torsional and bending stresses and then use the standard size of bearing for that size shaft. While it generally happens that this gives a sufficiently large bearing surface, it is apt to be disastrous when it does not, and a few minutes spent in making sure that the bearing pressure is not too great is time well spent.

On the other hand, some designers forget or neglect to take into account the action of the lever arm of the shaft in reducing the load on a bearing. This, with a shaft in a pair of bearings, makes one bearing of the pair larger than needed, while the other bearing will be too small. For the sake of uniformity it may be desirable to make both bearings of the same size but it must not be assumed that each bearing will carry half of the load. Take the case of a shaft with a gear and pinion, used as a part of the reduction gearing. An average example of this type is shown in Fig. 1.

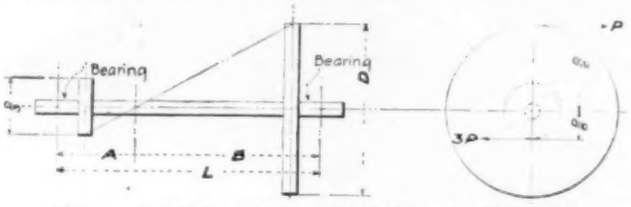


FIG. 1. TYPICAL ARRANGEMENT OF BEARINGS

Taking the gear diameter as being three times that of the pinion, the load on the pinion teeth will be three times the load on the gear teeth. The total load on the two bearings, will be equal to

$$\frac{P \times \left(\frac{D}{6} + \frac{D}{2}\right)}{\frac{D}{6}} = \frac{P \times \frac{4D}{6}}{\frac{D}{6}} = 4 \times P$$

or, is equal to the load on the gear teeth plus the load on the pinion teeth. This total load will be divided between the two bearings in inverse proportion to the lengths A and B, which are the lever arms of the load on each bearing. The load on the bearing nearest the pinion will be $\frac{4P \times B}{L}$, and on the other bearing $\frac{4P \times A}{L}$.

In the arrangement shown in Fig. 2, the total load P + P, is taken by the one bearing, but as the load point will not usually come central with the bearing center line, the bearing will tend to wear more on one side than the other, and the second bearing should be fitted to keep the shaft from getting out of alignment.

When the gear is transmitting motion to a long shaft, we have an arrangement like that shown in Fig. 3, the load on each bearing is then $\frac{P \times A}{L}$ and $\frac{P \times B}{L}$, the latter being the load on the bearing nearest the gear.

For belt drives, the calculation of the load on the

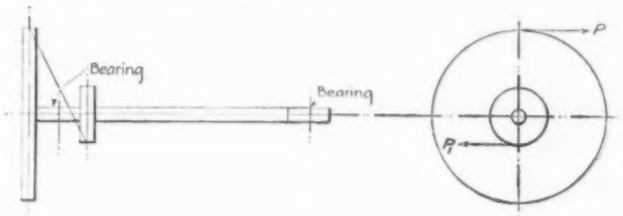


FIG. 2. ONE BEARING TAKES MOST OF THE LOAD

bearings cannot be made so exactly, as it involves estimating the tension that will exist in the slack side of the belt. But for the average case we can safely assume that the total pull on the bearings will not exceed twice the pull required to transmit the power. This load will be divided between the two bearings in the same proportion as shown in Fig. 3.

The pressure per sq. in. of bearing surface that can be safely allowed is the pressure which will not squeeze out the lubricant from between the surfaces. When the pressure is applied intermittently, and especially if the pressure reverses in direction, it will take a much greater pressure to break down the film of oil than if the pressure is continuous. The method by which the oil is applied has also considerable effect on the pressure that can be carried. The lubricant should always be introduced into the bearing at a point where there is no pressure, the capillary attraction will then draw the oil in between the surfaces and so maintain the film under a higher pressure than could be used if the oil were introduced at a point of the bearing which was under pressure.

Assuming that the oil supply is well looked after and the oil channels so arranged that the lubricant will

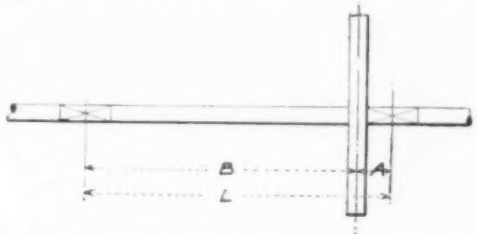


FIG. 3. BEARINGS WHERE POWER IS TRANSMITTED THROUGH A LONG SHAFT

have an easy passage to the point of greatest pressure, the following bearing pressures in lb. per sq. in. may be used as a maximum, under the respective conditions specified. The area of the bearing surface being taken as the diameter of the bearing multiplied by its length.

Bearing with intermittent reversing loads at very slow speeds 3000.

Bearing with intermittent reversing loads at moderate speeds 1200.

Bearing with intermittent reversing loads at ordinary speeds 900.

Bearing with intermittent reversing loads at high speeds 500.

Bearing with intermittent loads 400.

Bearing with continuous loads 300.

American Milling Machine Co. No. 1½ Plain and Universal Milling Machines

By J. V. HUNTER
Western Editor, *American Machinist*

The development of a machine differing in design from the several models that preceded it is seen in this new milling machine brought out by one of the more recent builders of this line of machine tools.

THE excessive demand for milling machines of all sizes and types has been one of the outstanding features of the machine-tool market during the past few years. Many existing models have been discarded for something newer, so that our pages are continually showing something that the maker considers better than that which he has built in the past. In this category are the models of No. 1½ plain and universal back-geared milling machines built by the American Milling Machine Co., Cincinnati, Ohio.

The plain back-geared milling machine is shown in Fig. 1. A heavy flanged base has been provided, with a box-form section of column, tapering from the base to the top. The knee is fitted to the column with adjustable gibs. Power feed is provided for both the cross and longitudinal feeds. All operating levers are on the front of the machine, with the exception of those for the feed gears. The feed-gear box is located on the left-hand side of the column at the rear, and the feeds are concontrolled by means of three levers. There are sixteen feeds ranging from 0.005 to 0.212 in. per revolution of the spindle. All of the steel gears are heat-treated and all shafts are ground and run in bronze bushings. The cut-

FIG. 1. AMERICAN NO. 1½ PLAIN BACK-GEARED MILLING MACHINE

Specifications: Working surface of table, 46 x 10½ in. Power longitudinal feed, 25 in. Power cross feed, 9 in. Hand vertical feed, 19 in. Face of column to over-arm brace, 21⅝ in. Size of taper hole in spindle, No. 10 B. & S. Spindle speeds, 16, ranging from 12 to 382 r.p.m. Distance from over-arm to center of arbor, 6½ in. Four-step cone pulley with largest diameter 11 in. and smallest diameter 7⅞ in. Width of belt, 3 in. Sixteen feeds ranging from 0.005 to 0.212 in. Two-speed countershaft, 107 and 265 r.p.m. Countershaft friction pulleys, 12 x 4 in. Floor space, 85 by 64 in. Net weight, 3,000 lb. Weight crated, 3,250 lb. Weight boxed for export, 3,700 lb. Export case, 118 cu.ft.

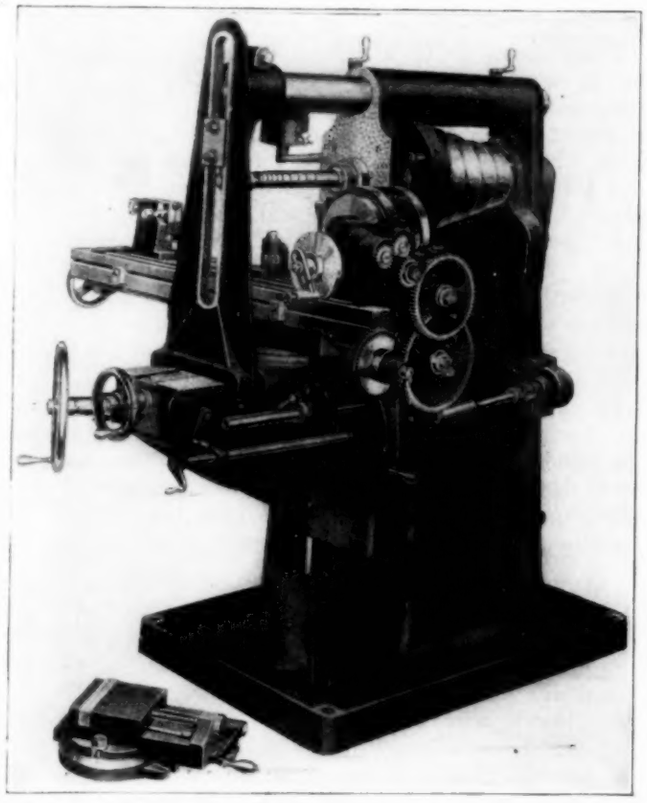


FIG. 2. AMERICAN NO. 1½ UNIVERSAL BACK-GEARED MILLING MACHINE

Specifications: Same general dimensions as for the plain milling machine. Universal table swivels 54 deg. on each side of center; 11-in. universal dividing head. Net weight, 3,400 lb. Weight crated, 3,650 lb. Weight boxed for export, 4,100 lb. Export case, 118 cu.ft.

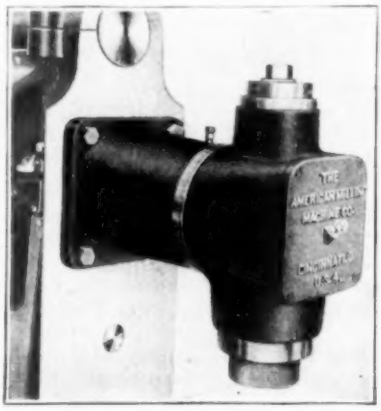


FIG. 3. AMERICAN VERTICAL MILLING ATTACHMENT

ter spindle runs in bronze bearings; the front one is 5 in. in length, and has a No. 10 B. & S. taper hole. Sixteen spindle speeds are obtained, using the four-step cone pulley together with a two-speed countershaft and the back gears, which are of a 6 to 1 ratio. The speeds range from 12 to 382 r.p.m. An overarm of 3¾ in. diameter and brace are provided.

The universal type of machine is illustrated in Fig. 2. The table swivels through 54 deg. on each side of the center. It is also provided with a swivel vise and with an 11-in. universal dividing head.

When desired, the swiveling vertical milling attachment shown in Fig. 3 can be furnished. This attachment is secured to the face of the column by four screws and located by the front spindle bearing. The body of the attachment swivels through a complete circle and has a graduated dial so that it can be set in any desired position. The columns of all machines are drilled and tapped so that this attachment can be applied at any time. The distance from the face of the column to the center of the spindle is 10½ in.

Harmful Tendency in Trade Education

By Entropy

B. A. Tibbab, whose name sounds much more euphonious spelled the other way around, takes a fling at trade school graduates under the above title on page 74 of the *American Machinist*. There is no doubt but that the instances he cites in which boys have been exploited under the name of trade education can be duplicated many times over, and yet it is not fair to judge trade education in terms of individual instances like these selected by a prejudiced observer. Any one interested in making out a good case can find many more cases in which the boys have profited immensely by their training and have come out so trained that they have very promptly taken their places alongside of men of long years of experience in the shops.

The criticism made by Mr. Tibbab sounds almost as though he did not believe it right for boys to be trained as machinists on machine work done as it is done in the shops into which they must go to earn their living. It sounds like a plea for manual training methods instead of practical methods. He would apparently take an order for 250 spindles and distribute them among the 250 boys in the school and have each make one all the way through. In the shop (commercial shop) one man would take all of the blanks and straighten and center the lot, another man would square the ends of all before he started to rough turn any. Why not do it the same way in a trade school? To be sure professional educators will tell us that the boy who has once straightened and centered a shaft without the aid of luck has derived all the educational value of the "Exercise," but that is not what we are after. We are trying to train a boy so that he can straighten shafts with certainty, celerity and confidence, and no man ever learned that on one shaft. To be sure if he has straightened 250 one-inch shafts he will not need to straighten so many two-inch shafts in order to get the hang of it, but at some time or other before graduating or after he must straighten enough shafts so that it is perfectly natural for him to do it, and he can do it without having to reason out every move as he goes along. Suppose Mr. Tibbab were to learn to ride a bicycle. It would not be enough for him to know the principles of balance, but he would have to apply those principles long enough so that balancing would be just as natural as walking before he ought to venture into traffic.

This does not mean that every boy who comes into the trade school should have to straighten and center 250 of those particular shafts for Blank & Co. He might only straighten 225 for the Roe Manufacturing Co. Or he might have a lot for one concern this week and another lot next fall, but it does mean that sometime in his course he would perform these operations for a considerable number of shafts, and that the school would look out that every boy had a reasonably large number of these shafts to do before he went ahead on work which was much advanced beyond that point. It would not mean that every boy would straighten 250 shafts. One boy might straighten 100 and another 500, provided the first boy caught the trick promptly and the second boy was slow to pick it up. It would not necessarily mean that the second boy was to have a lower mark either, for he might be slower to learn.

The principle of teaching a boy to make things in quantities rests on giving them to him in quantities for practice. If it appears to some manual training teacher that he is being exploited he should investigate pretty carefully before he is too certain of his statements. It may be, as has often happened, that the boy only partially completed his course and then claimed, without any foundation, that he was kept so long on one job that the school was making a profit. If the other side of the story was told it might be found that the boy was unteachable and that the apparent exploitation was an attempt on the part of the instructor to get him to do some thoroughly good job at something before he pushed him ahead. I do not doubt that Mr. Tibbab will grant that it is wise to be thorough. We used to have as the slogan of the Worcester Trade School, "Do your work habitually well," which proved a very good motto for consumption by the students and their parents.

We have seen a great deal of emergency training in so-called vestibule schools during the war which was amply justified by the emergency, and which proved wise and profitable because of the great amount of repetition work done. Men and women were taught to become necessary cogs in a great war mechanism, but rather unintelligent cogs. What is needed for constant growth of our industries is that the workers shall be intelligent forces knowing the reason why they do their work, knowing the processes through which it has passed before it reaches them, and the processes which are to follow, so that they can say of the finished product, "That is better for the care with which I heat-treated this part, or for the care with which I fitted that." These things cannot be taught by the vestibule system alone, nor on the other hand can they be impressed on a boy's mind thoroughly without driving the facts home by constant and thorough training on the actual job. A technical graduate could undoubtedly go into any of our machine shops and in a very few days, if he were so inclined, learn to perform any one operation as well and perhaps better than the men who ordinarily do it, but that would be like taking a sixteen-inch gun to hunt quail. The boy who goes to a trade school thereby rates himself as of a lesser caliber than if he aspired to an engineering education, but in many instances he is simply mistaken and he may become an engineer in spite of his training, but the teaching methods of a trade school must be adapted to the needs of the average boy.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

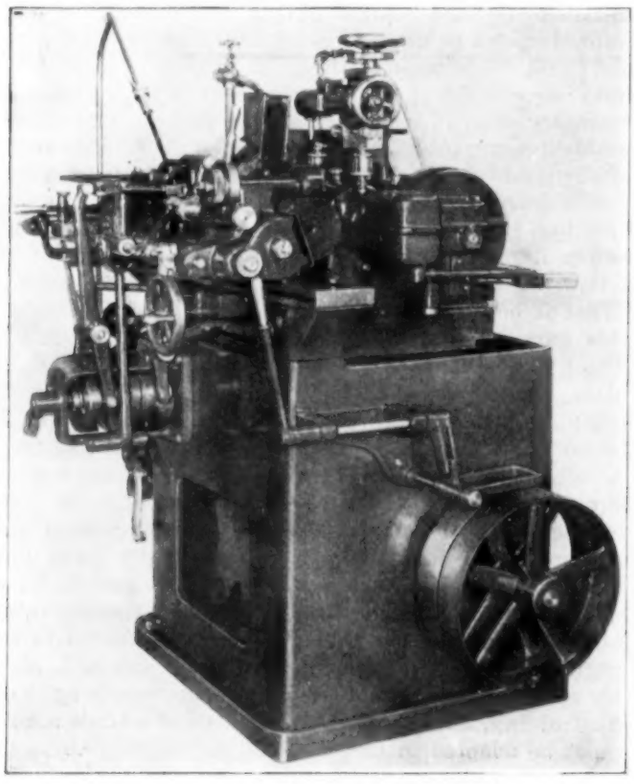
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Fraser Full-Automatic Grinding Machine

The grinding machine herewith illustrated is the product of the Warren G. Fraser Co., Westboro, Mass.

The machine is intended for grinding rolls and other small work where the length of the surface to be ground does not exceed the width of the grinding wheel.

The work is placed in a magazine and fed by gravity to the machine. The automatic control unit consists of a cam-set rotated by worm gearing and in its cycle accomplishes the following: Swings the feed arm from the magazine to the chuck, holding the work until the chuck grips one end and the tailstock center enters the other end; brings the grinding wheel quickly to a predetermined position, then traverses it across the work for a predetermined distance, holds it stationary for a predetermined number of revolutions of the work, moves it quickly back to the starting position, stops rotation of the work, opens the chuck jaws and moves the tail center back, allowing the work to drop out. Both the wheelhead and headstock rest on three-point bearings. The wheel-spindle is hardened and ground and runs in bronze boxes which are adjustable for wear. The wheel-slide is adjusted by a screw having a graduated handwheel to obtain the proper size for work being ground and to correct for wheel wear.

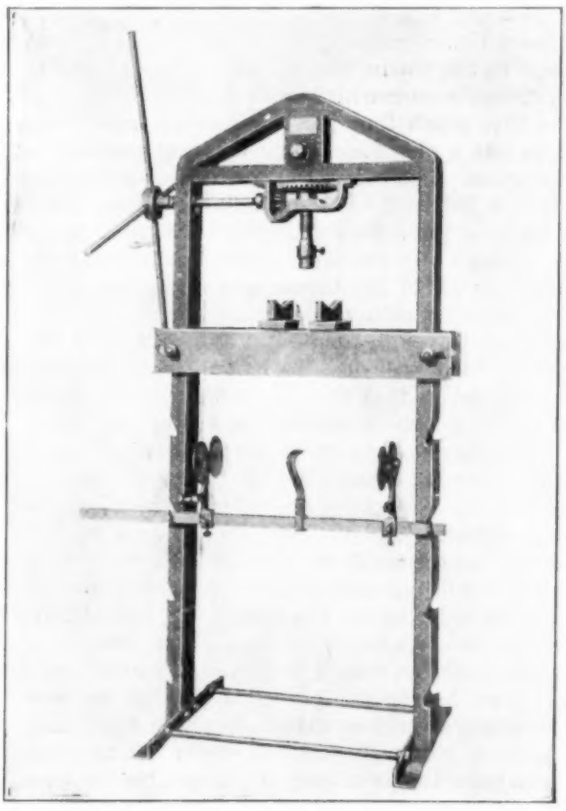


FRASER FULL-AUTOMATIC GRINDING MACHINE

Detroit Combination Arbor Press

The Detroit Garage Equipment Co., Detroit, Mich., has placed on the market the combination straightening press, arbor press and truing machine shown in the illustration. It is intended primarily for automobile repair work.

The frame of the machine is formed from one piece of 6-in. channel steel, the cross member and vertical strut at the top being welded in place. The screw is hand operated through bevel reduction gears, is 2 in. in diameter and has a travel of 9 inches. The work is supported on two ¾ x 6-in. plates. A truing device is provided for use when straightening shafts. This



DETROIT COMBINATION ARBOR PRESS

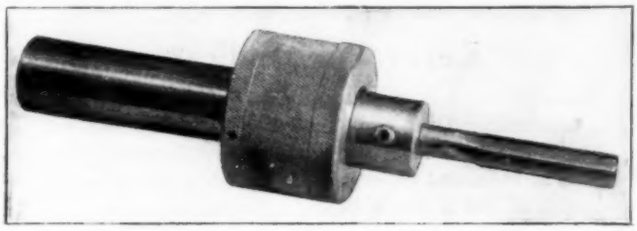
device consists of a movable indicator holder, centers, and disks mounted on a rail 5 ft. long and removable, if necessary.

The guaranteed capacity of the press is 50 tons, but it is stated that as much as 200 tons pressure can be obtained. The height of the machine is 85 in., the width 35 in., and the weight 615 pounds.

Scully-Jones Floating Reamer Holder

The floating holder shown in the figure is made by Scully-Jones & Co., Railway Exchange Building, Chicago, Ill., for holding reamers in turret lathe and similar work where it is important that the reamer be permitted to float freely in its axis of rotation and find its own center so as to insure straight round holes. Short shank reamers can be used in this holder, thus reducing the cost of high-speed finishing reamers.

It can be furnished with various types of collets for driving all types of reamer shanks and all styles of finishing tools where a floating holder is required. The



SCULLY-JONES FLOATING REAMER HOLDER

holder can be furnished with a shank to fit any size of turret lathe or with any size of taper shank to fit drilling-machine spindles or lathe tailstocks.

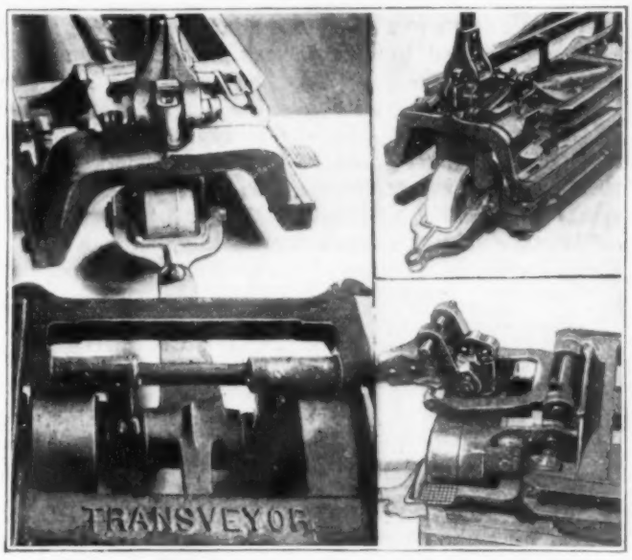
All parts with the exception of the shank are hardened throughout. The latter is left soft so that at any later time it can be changed by the customer to fit the spindle of a machine differing from the one for which it was originally intended. The holder is made in four sizes.

Improvements in Cowan Transveyors

The Cowan Truck Co., Holyoke, Mass., has added some improvements to its Transveyor truck. On the left of the illustration is shown an attachment that enables the Type G Transveyors to be used as trailers behind electric storage battery trucks, either singly or in trains.

The attachment requires no change in the construction of the truck, except a longer axle for the front wheel so that the coupling yoke can be mounted. The draw bar can be applied to the truck without taking off the wheels, as it merely slips over the rear axle. Both the attachment and the draw bar are steel castings.

It is stated that the two parts of the hitch are so proportioned that the shortest possible connection is provided for; that the tracking is almost perfect and that the turning radius is so short that a train of ten trucks has been turned in a circle on a 20-ft. roadway. Up and down play is allowed, so that there will be no binding as the machines go over door sills or the tops of steep inclines. The two views at the right show a latch for holding up the handle of the type G truck when it is not in use. It is made of two leaves of tempered spring steel attached to the top of the king pin. As the handle is thrown back into a vertical position, it slips over the

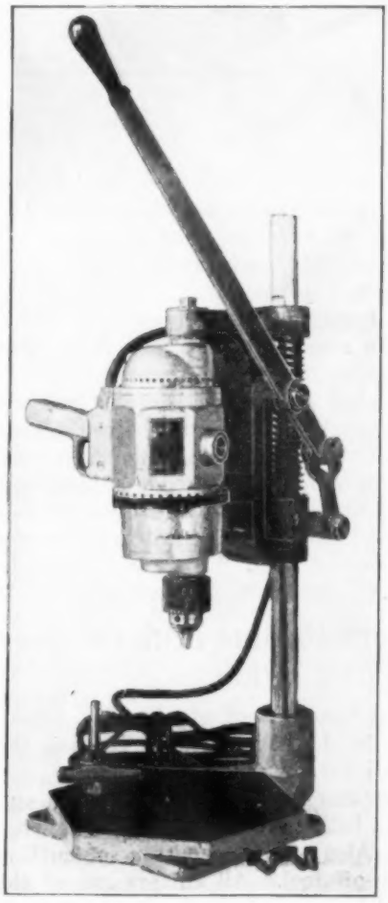


TRAILER ATTACHMENT AND SAFETY HANDLE-LATCH FOR TRANSVEYOR

spring, and jarring will not cause it to fall forward. The latch, however, does not interfere with the free movement of the handle, when it is necessary to bring it down to manipulate the truck.

Black & Decker Bench Drilling Stand

A bench drilling stand which has just been put on the market by the Black & Decker Manufacturing Co., Baltimore, Md., takes $\frac{3}{8}$, $\frac{1}{2}$, $\frac{9}{16}$, $\frac{5}{8}$, and $\frac{7}{8}$-in. Black & Decker portable drills. The bracket carrying the drill can be raised or lowered on the vertical column and is secured in any position by means of a split collar and clamping screw. The drill may be swung clear of the base, making it possible to use this stand for such work as applying ring gears to automobile axles, drilling in the ends of shafts, and other work too high to be drilled on the bench. The feed lever gives a feed ratio of 6 to



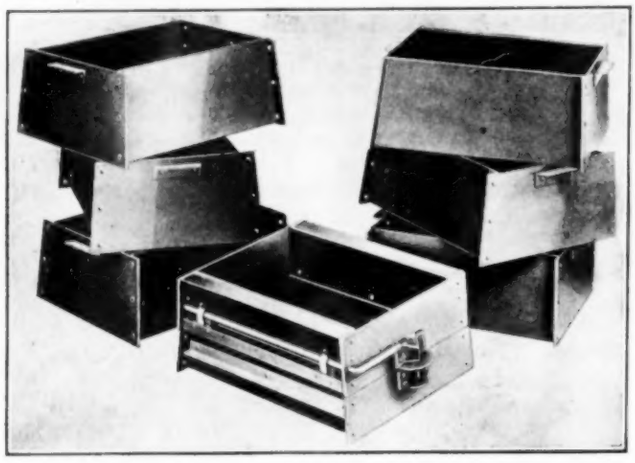
BLACK & DECKER BENCH DRILLING STAND

Specifications: Height (bottom of base to top of vertical column), 30 in. Vertical adjustment of drill, 12 in. Drilling radius (distance from center of drill bit to circumference of vertical column), 7 in. Horizontal adjustment of drill, 360 deg. Feed (vertical travel of drill when operated by feed lever), 4 in. Net weight, 70 lb. Shipping weight, 110 lb. Shipping dimensions, 19 x 14 x 33 in.

1. In the base are six tapped holes to accommodate ½-in. studs, used to clamp work in place. One stud with nut and clamp is supplied with stand. Stand is shipped complete with adapter block to take Black & Decker ¼, 5/16, or ⅜-in. drills, types C-D-DG-E-EG-EF-EGF-F-FG. If stand is desired for use with ⅜-in. Black & Decker portable electric drills or ¼-in., or for ½-in., 5/16-in. and ⅜-in. Black & Decker portable electric drills other than the types named, the size and type as shown on the name plate of the drill should be specified.

Oliver All-Steel Self-Releasing Snap Flask

The illustration shows the all-steel self-releasing snap flask and jackets being manufactured by the Oliver Machinery Co., Grand Rapids, Mich. The flask and



OLIVER ALL-STEEL SELF-RELEASING SNAP FLASK WITH JACKETS

jackets are of simple construction, being tapered 5 deg. so that it is easy to lift them perpendicularly from the mold. They are made of 8 to 10 gage steel and all parts are riveted together. It is said that their all-steel construction is economical, as they last longer, take up less room, have less repair costs, and are less liable to be burned than the wooden types; also that more and better castings can be made from them.

The flask is constructed with angle irons to make it rigid and has sand supports at its parting line. These supports are connected to levers which, when depressed by the operator, withdraw them to the edge of the cope, thus enabling him to lift both cope and drag with a minimum of care. The jackets are claimed to fit exactly the molds that the flask makes.

Smith Standard-Radius Lathe and Planer Tools

The R. G. Smith Tool and Manufacturing Co., 315-17 Market St., Newark, N. J., has added to its line the radius tools illustrated herewith.

A set of tools comprises a spring toolholder, and cutters from 1/16 to 1 in. both convex and concave varying by 16ths of an inch. Also a 60-deg. cutter for cutting threads and a cutting-off tool. All cutters are of the formed type and need be ground on the face only. If the faces are ground radially the original shape will

SMITH STANDARD-RADIUS LATHE AND PLANER TOOLS

be preserved until the cutters have been used up by grinding. Special cutters and holders can be furnished to order.

Keller Dial Indicator

The Atcheson Tool and Die Co., 609-613 North Fourth St., Columbus, Ohio, has recently placed on the market the Keller indicator shown in the illustration. The device is intended especially for gaging the diameter of cylindrical work while being rotated, as on a grinding machine.

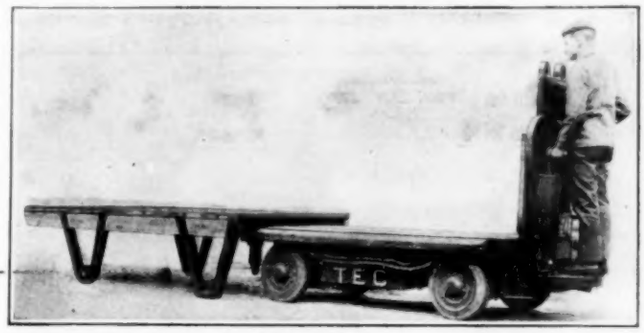
The indicator dial is mounted on the end of a shaft, through which a pin, connected with the indicator and provided with a hardened tip for touching the work, extends. The shaft is held in a split bushing, so that it can be slid either toward or away from the work. The bushing is so mounted on a link that its height can

KELLER DIAL INDICATOR

be adjusted. The base of the device can be bolted to the table of the machine on which it is used, and the indicator may then be adjusted in two planes. It is claimed that the device can be quickly adjusted, that it is very accurate and that it facilitates rapid production.

Tec Industrial Platform Truck

The platform truck illustrated is manufactured by the Terminal Engineering Co., Inc., 17 W. 44th St., New York City. The rated capacity is 5,000 lb. and



TEC INDUSTRIAL PLATFORM TRUCK

Specifications: Drive and elevating motors, G.E., 60 volt, series wound. Frame 4-in. steel channel. Tires, 20 x 5 in. solid rubber. Springs semi-elliptic, 2 x 26 in. leaf. Controller, drum type. Coupler for trailers, automatic, uncoupled from dash. Accessories: Red and white electric running lights with Conaphore lens, electric horn, license plate brackets, Sangamo ampere hour meter, Veeder odometer, combination latch lock on controller.

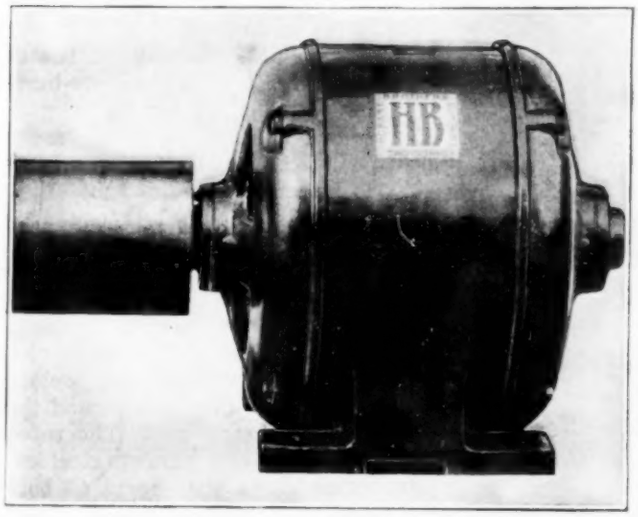
the rated speed is ½ to 10 miles per hour light and ½ to 7 miles per hour full load. The elevating mechanism consists of four steel screw jacks driven by roller chain direct from an electric motor. The batteries are ironclad Exide 34 cell M.V. 9 or 34 cell M.V. 11, or Edison 59 cell A-4 or G-6. They have three-point support.

The drive is the four-wheel type, with a motor on each wheel. Steering also is done through the four wheels. The platforms have pressed steel legs and 2-in. spruce planking.

Hobart Brothers HB Motors

The Hobart Brothers Co., Troy, Ohio, has brought out a line of electric motors from 1 to 10 hp., one of which is illustrated herewith.

The d.c. motors are equipped with starting boxes,



HOBART ELECTRIC MOTOR

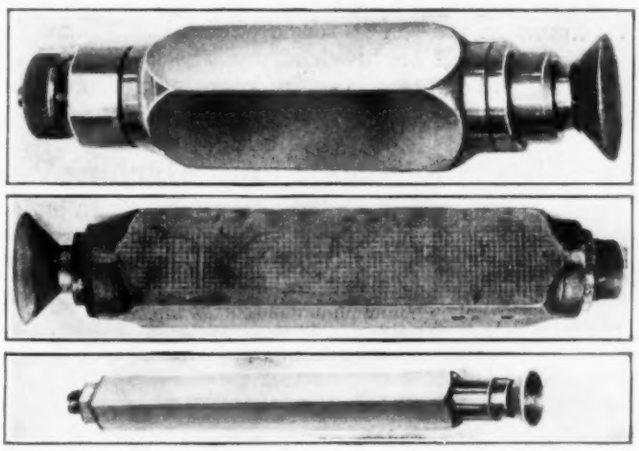
the 7½- and 10-hp. units having compensators also. All the motors have ball bearings and are furnished with base tracks and pulleys. On motors below 5 hp. the pulleys are 4 x 4 in.; on 5 hp. and above they are 6 x 4 in. The speed of all the motors is 1,800 r.p.m. The a.c. motors can be furnished in either 2 or 3 phase and practically any cycle and voltage and the d.c. motors in any voltage. The weights of the different sizes are as follows: 1 hp., a.c. 140 lb.; d.c. 180 lb. 2 hp., a.c. 160 lb.; d.c. 200 lb. 3 hp., a.c. 210 lb.; d.c. 250 lb. 5 hp., a.c. 315 lb.; d.c. 340 lb. 7½ hp., a.c. 590 lb.; d.c. 600 lb. 10 hp., a.c. 650 lb.; d.c. 675 lb.

"Commercial" Grinding Wheel Dressers

The Commercial Welding and Machine Co., Worcester, Mass., has recently placed on the market three styles of grinding wheel dressers. The dressers all use conical cutters and are provided with tool-steel spindles.

The dresser at the top of the illustration is equipped with a double ball bearing in the front end and a ball radial and thrust bearing in the rear. Different sizes of cutters can be used. The tool is made in 2- and 2½-in. sizes, the standard length being 6 inches.

The dresser shown in center is equipped with straight roller bearings and a ball thrust bearing. It is made in two sizes, the casing being either 2 or 2½ in. square.



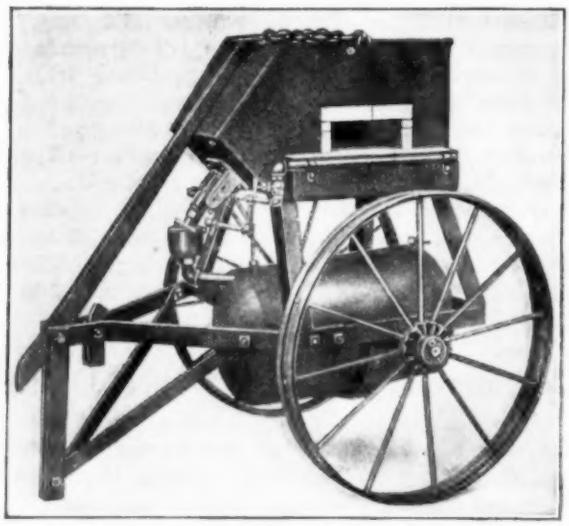
COMMERCIAL GRINDING WHEEL DRESSERS

The bottom dresser is small enough to permit its use on small cup and cylinder wheels. The spindle runs in a soft bushing, has a ball end adjustment and ordinarily carries a ⅞-in. conical cutter. The casing is ⅝ in. square.

Mahr Portable Oil-Fuel Rivet Forges

The Mahr Manufacturing Co., Minneapolis, Minn., has placed on the market the portable oil-fuel rivet forge shown in the illustration. The device is intended especially for car repair work or for work performed in yards where the forge must be trucked over uneven ground. It is mounted on two large, wide-tread wheels fitted with roller bearings, the third point of support being provided by the leg of the steel frame to which the handle is attached. It is designated as the No. 18 forge.

The burner and the forge proper are the same as the stationary type of rivet forge described in the *American Machinist* on page 432. Either fuel oil or kerosene may be burned, and compressed air is employed



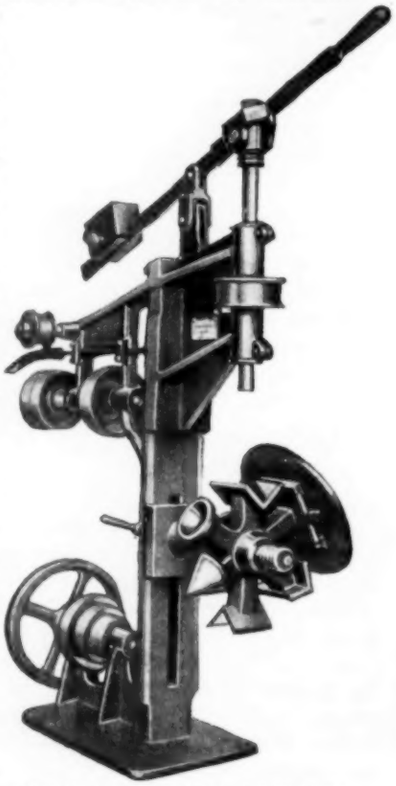
MAHR PORTABLE OIL-FUEL RIVET FORGE NO. 18

at a pressure of from 30 to 120 lb. per square inch, the air consumption being 8 cu.ft. of free air per minute. The burner operates on the vacuum principle, drawing oil from an 18-gal. fuel tank. The forge has a capacity of four hundred ¾ x 3-in. rivets per hour.

For boiler shops and for use on level floors, this same type of forge is mounted upon a different style of truck and known as the No. 15 forge. Three small-diameter, wide-tread wheels are provided, one wheel being swivel-mounted. All joints of the truck are welded, and the fuel tank serves as the principal member of the frame.

Mellon Bench Drilling Machine

G. R. Mellon, 380 Wayne St., Jersey St., N. J., builds the bench drilling machine shown in the illustration. The machine, which was originally described in the *American Machinist*, May 15, 1913, has been redesigned, so as to give greater strength and stability. Lever feed is provided, the thrust being taken by a bronze and fiber bearing. The spindle runs in long bronze bearings, being belt driven. The chief feature of the machine is the monitor table carrying different forms for holding the work. The flat table can be easily detached. The fixture makes it possible to readily drill holes centrally in balls and shafts. To bring the proper form under the spindle, the monitor table is pulled out, thus disengaging it. It can then be rotated, and when released it locks itself in position automatically.

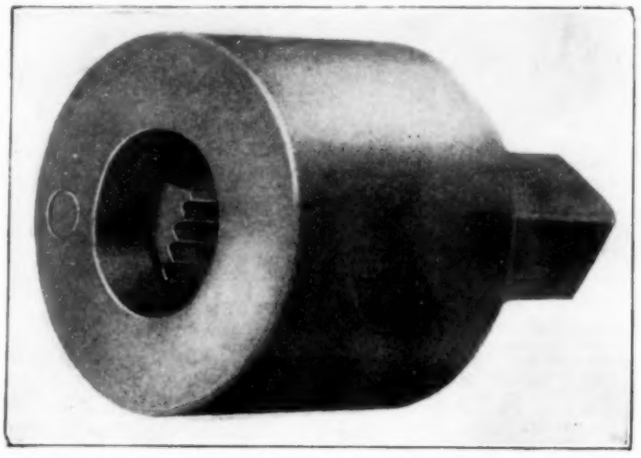


MELLON BENCH DRILLING MACHINE WITH MONITOR TABLE

Specifications: Capacity up to ¾-in. drills. Spindle to table, maximum, 11 in. Spindle: travel, 3¾ in.; diameter, ¾ in.; hole, No. 1 Morse taper. Diameter of table, 8 in. Number of speeds, 3. Extreme height, 40 in. Net weight, 125 lb.

"Perfection" Reversible Stay-Bolt Chuck

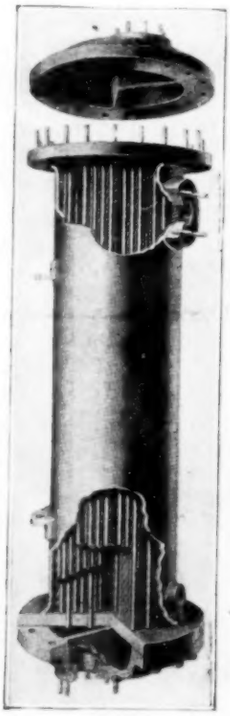
The stay-bolt chuck shown in the illustration is being manufactured by the Lovejoy Tool Works and sold through Tom Brown & Co., 800 Great Northern Building, Chicago, Ill. The chuck grips round staybolts, either threaded or blank, and saves squaring the ends.



PERFECTION REVERSIBLE STAY-BOLT CHUCK

Specifications: Built in three sizes: No. 1 for bolts from ⅜ to ⅝ in.; No. 2 from ⅝ to 1 ⅛ in.; No. 3 from 1¼ to 1¾ in. Either square shank or Morse No. 3 taper furnished as ordered.

It will drive in either direction, so that when necessary it can be used for backing out the bolts. The chuck can be furnished with either a square or Morse taper shank. It is made in three sizes, each size fitting three different sizes of bolts.



GRISCOM-RUSSELL "G-R" OIL HEATER

Griscom-Russell "G-R" Oil Heater

The Griscom-Russell Co., 90 West St., New York, N. Y., has recently placed on the market an oil heater unit of the straight-tube type. This device, shown in the accompanying illustration, is known as the G-R oil heater and is intended for the pre-heating of fuel oil before it goes to the burners, so as to insure complete atomization and perfect combustion of the fuel. The oil is pumped through the tubes, making 3 passes between the inlet and the outlet, and high-pressure steam in the shell serves as the heating medium.

The shell of the heater is constructed of wrought steel welded to the steel tube sheets, and the heads are cast iron. The tubes are of seamless drawn steel expanded into the sheets at both ends. Perforated steel baffles are placed in the steam space. If

desired, the tubes can be fitted with agitators for increasing the oil velocity and the rate of heat transfer. No fittings are required. The heater is made in a wide range of sizes, the weights varying from 150 to 3,100 lb.

Some Jigs for Drilling Harvesting Machine Parts

By H. W. Johnson

Harvesting machinery presents some odd problems to the tool designer. Fig. 1 shows a casting in which hole *B* is cored to size and is not to be bored. The balance of the work is to be jigged from this hole and from the flat side of the casting. It is necessary that provision be made for supporting the casting against the thrust of the boring tools, and this support must be so arranged as to need no adjusting, even though some variation be met in the shape of the casting. A set of jigs which meets these requirements very closely is shown in the illustrations. They were made at the Harvester Plant of the Moline Plow Co.

The first operation is to bore a 1⅜-in. hole as at *A*, Fig. 1. This hole is cored 1⅞ in. in diameter, and is bored with a 3-lip high-speed drill at 183 r.p.m., feeding 0.040 in. per revolution. The casting is laid on the flat bottom member of the jig, shown at the left, and is located by a conical top piece which enters an annular recess around the hole.

This jig is typical of a line of such tools used in the Moline plant, the upper members of which are raised by a lever and held down by two powerful springs when the lever is released.

The second operation is done in another spring jig, shown at the right-hand side of Fig. 1. Inspection of this illustration will show a flattened stud in the jig base. The cored hole *B*, which is not to be bored at all, but used as a locating point for the other holes, is slipped over this stud. The upper member of the jig is a steel bushing, countersunk to slip over the boss on the upper end of the casting. One side of the countersink is entirely cut away and allows the work to be forced back against the four bearing spots *C* on the flat support at the rear, thus establishing the distance from the flat side of the casting to the hole being bored. The thrust of the boring tool is taken by the strut *D*. A flattened stud *E* is pushed into the hole which was bored by the first operation. This stud does not locate the castings. It simply resists torque. It is flattened horizontally in order that the casting may surely rest on the strut *D*, even though there be some small variation in the castings. The hole bored by this operation is 1⅞ in. in diameter.

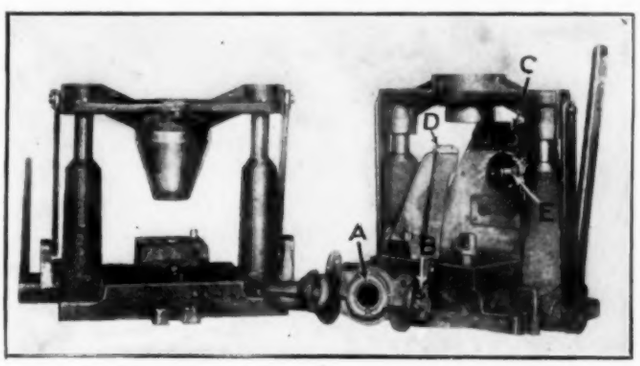


FIG. 1. JIGS FOR OPERATIONS 1 AND 2

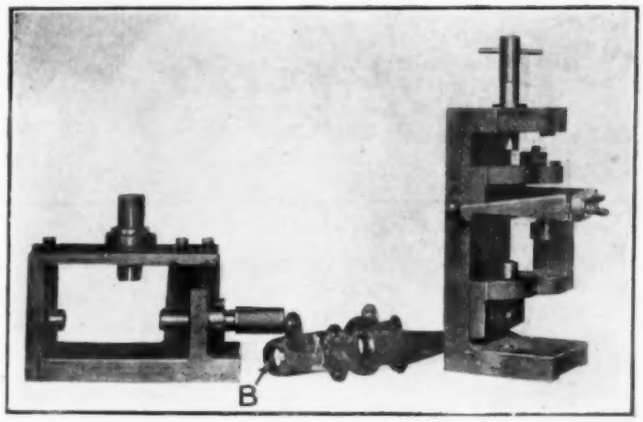


FIG. 2. JIGS FOR OPERATIONS 3 AND 4

The third operation is done in the tall jig shown at the right in Fig. 2. The lower stud enters the cored hole *B*, a sliding plug is dropped into the hole bored by operation 2, and the casting is fastened against a hardened locating stop by a quick-acting clamp operated by a wingnut. In this operation the hole is drilled from the solid, using a ⅞-in. high-speed drill. Speed, 458 r.p.m.; feed, 0.0012 in. per revolution.

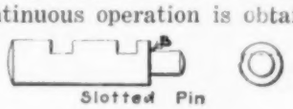
In the final operation five ¾-in. holes are drilled from the solid in the jig at the left. Locating is from the cored hole *B* and the two large bored holes by means of one solid and two sliding plugs. Speed, 610 r.p.m.; feed, 0.010 in. per revolution.

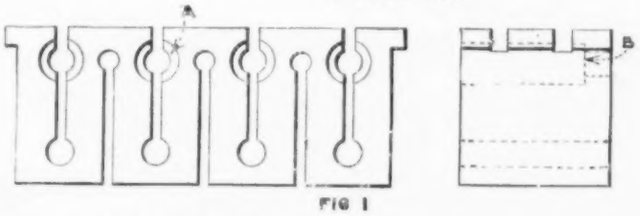
A Spring Block for Use in a Milling-Machine Vise

By H. M. Fay

The illustration, Fig. 1, shows a pin with two slots milled across it. This pin, being but ⅞ in. diameter by 1¾ in. long, was rather difficult to hold and as a solution of this difficulty the split block shown below the pin was used. The block has four holes *A* in it, and into each of these holes one pin is placed, the shoulder *B* on the pin serving to locate it lengthwise. The block with the four pins is gripped in the milling machine vise as shown in Fig. 2 and by tightening the vise in the usual manner the block is made to grip the pins securely.

The principle involved is similar to that used in some expanding mandrels. By using two of these blocks, loading one while the machine is at work on the pins held by the other, continuous operation is obtained.





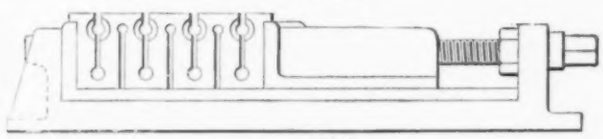


FIG. 1. FLEXIBLE BLOCK FOR HOLDING SMALL PINS
FIG. 2. THE BLOCK IN THE MILLING-MACHINE VISE

Forty-Two Cities To Celebrate Fortieth Anniversary of A. S. M. E.

Engineers will gather simultaneously in forty-two cities on Nov. 5, to celebrate the fortieth anniversary of the founding of the American Society of Mechanical Engineers. Plans being made at the national headquarters of the society, 29 West 39th St., New York, it was announced, include the transmission by radio-telephone of speeches reflecting engineering ideals to be delivered here by the heads of the leading engineering organizations, including Herbert Hoover.

Speakers prominent in the affairs of the society will make addresses in each of the forty-two cities represented by local sections. In New York it is planned to have these meetings addressed through the radio-phone and at a central celebration by Fred J. Miller, president of the American Society of Mechanical Engineers; Herbert Hoover, president of the American Institute of Mining and Metallurgical Engineers; Arthur P. Davis, Washington, D. C., chief engineer of the United States Reclamation Service and head of the American Society of Civil Engineers, and Arthur W. Berresford, of Milwaukee, head of the American Institute of Electrical Engineers.

Speakers at the celebrations will dwell upon the engineer as a constructive force in civic progress as evidenced by the movement to reorganize the Federal Departments at Washington, now indorsed by both the Democratic and Republican parties. The plan to coordinate the immense public works functions of the Government, it was pointed out recently by making over the Department of the Interior into a department of public works, was originated in Engineering Council, of which J. Parke Channing, of New York, is chairman.

This Is Hardly Slavery

Kansas' new industrial court has been denounced by Mr. Gompers and other labor leaders as a devilish contrivance designed to enslave wage earners and reduce them to a state of abject servitude. If such is the purpose of the court its methods are Machiavellian. Listen to this extract from an opinion it handed down in a recent case involving members of the International Brotherhood of Stationary Firemen and Oilers employed by the Union Pacific railroad:

> These men are required to work seven days in the week in order to earn a sufficient wage to support their families even scantily. The evidence shows a state of facts which would unquestionably warrant this court in taking jurisdiction in order to preserve the public peace, protect the public health and promote the public welfare.

The court announced a new wage scale based on an eight-hour day with time and a half for overtime, Sundays and legal holidays, and then remarked on the seven-day week:

> The members of the court feel that the seven-day week ought to be discouraged. The occupation in which these workers are engaged must necessarily operate seven days in the week, but where ever it is reasonably possible to do so a revolving system should be used so that individual workers will be allowed one day's rest and recreation in seven.

No order compelling the adoption of such a plan was issued, the court desiring to give the employer time and opportunity to work out the details of such a scheme, but there is an unmistakable intimation that if action is not forthcoming the court will step in.

If this is the path to slavery, where, Mr. Gompers, is the road to justice and freedom?—*The Employer.*

"Management Education" Course To Be Established Throughout Country's Colleges

Plan an Outgrowth of Convention of Industry and Colleges, Held To Bring the Two to Working Agreement — Industry To Appropriate $100,000 Annually

A course in "management education" to provide a sufficient number of properly trained executives for the industries of the United States is to be established in a majority of the 620 American colleges, according to an exclusive announcement made to the Associated Press by Dr. Hollis Godfrey, president of the Drexel Institute, Philadelphia, formerly commissioner of the advisory commission of the Council of National Defense.

$26,000,000,000 Backing

The plan, an outgrowth of a convention attended by representatives of industry and colleges in Philadelphia last March, is backed by corporations representing a capitalization of $26,000,000,000. It is the result, Doctor Godfrey said, of these two factors coming to a definite working agreement for the first time through the establishment of the Council of Management Education, an organization formed "to study mutual problems in order that the colleges may render the greatest possible service to industry."

Doctor Godfrey, chairman of the new body, assisted by Dr. Samuel P. Chapen, general director of the American Council on Education, representing the 620 colleges, and Dr. Frederick C. Ferry, president of Hamilton College, are perfecting the plan, which contemplates establishing practical courses in the schools, assisting undergraduates and others to choose their life's work, by placing several thousand students and teachers in industry during the summer months and by introducing extension courses for men now in industry. By the summer work, students will be enabled to defray their expenses at college, obtain an insight into American industry and enable the executives to select men for future management.

The Council of Mangagement Education, which has been formed, it was said, to become "a clearing house for all industrial and educational matters in the country, to promote the mutual understanding of the mutual problems of industry and the college, and to keep perpetual inventory of the educational needs of industry and of the ability of the colleges to meet these needs," has opened temporary offices in the Drexel Building, Philadelphia, until headquarters are furnished in Washington.

An annual appropriation of $100,000, entirely borne by American industry, has been made to carry on its work, which has been divided into two classes: First, to determine the field of service which each college can cover, and, second, to provide the college with all industrial data which may be utilized in forming undergraduate courses for men contemplating entering industry and in reaching the management men already in industry through extension courses.

All of the courses and scholastic recommendations, it was said, will be passed upon jointly by the Council of Management Education and the American Council on Education before being forwarded to the institutions of learning. Within one year, it is estimated, 100 colleges will have included the extension industrial courses and all will be provided with the industrial material upon which to base undergraduate work.

Only Surviving War Organization

The council, acording to Dr. Godfrey, is the only war organization which has carried operations into time of peace Nearly all of the educators back of the movement served in the Council of National Defense. When the armistice was signed these men de-

LD'S INDUSTRIAL FORGE
News Editor

cided that the educational knowledge gained during the war at an expenditure of millions of dollars should not be lost. Accordingly, plans were set in motion to turn this information over to industry. A survey of the needs of industry was made under the auspices of the Technology Clubs Associated of the Massachusetts Institute of Technology.

In the most extensive industrial survey ever made, executives of 250 of the largest corporations in America agreed that increased production, decreased cost, increased stability and increased incentive were the most important needs. The convention in Philadelphia last spring met to discuss these needs. It was agreed by both college presidents and executives of America's industries that the needs of industry can be met only through proper education, and plans were made for the formation of the permanent Council of Management Education.

While the majority of American industries are represented on the council, those having members on the executive committee are the railroads, public utilities, oil, textiles, mining, rubber, leather and shoes, paper, machinery and cotton finishing.

The executive members of the council appointed to represent their industrial group are as follows: Railroads, A. W. Gibbs, chief mechanical engineer, Pennsylvania Railroad; paper, Colonel B. A. Franklin, vice president Strathmore Paper Co.; public utilities, H. B. Shaw, educational director, H. L. Doherty Co.; shoes and leather, Frederick B. Rice, president, Rice & Hutchins; mining, J. Park Channing, mining engineer; machinery and metals, Frederick H. Payne, Greenfield Tap and Die Co.; rubber, Dr. R. S. Quinby, service manager, Hood Rubber Co.; cotton finishing, J. K. Milliken, president, Mt. Hope Finishing Co.; textiles, Albert Bigelow, Ludlow Manufacturing Co.

The educational group includes, besides Doctor Godfrey and Doctor Capen, Dr. Frank Graves, dean of the school of education, University of Pennsylvania; Dr. Charles Tilden, professor of engineering mechanics, Yale University; Dr. David Tennant, professor of biology, Bryn Mawr College; Dr. Leigh Reid, professor of mathematics, Haverford College; C. L. Evanson, professor of engineering administration, Drexel Institute, and J. S. Pearson, professor of production engineering, Drexel Institute.

The American Council on Education has appointed the following committee as a permanent body to co-operate with the Council of Management Education:

Doctor Capen, chairman; Dr. Charles R. Mann, chairman of the advisory board educational training of the general staff, War Department; Frederick L. Bishop, dean engineering school, University of Pittsburgh; Park R. Kilbe, president Municipal University of Akron; Raymond Hughes, president Miami University.

Buffalo Builders' Exchange Votes "Open Shop" by 108 to 1

"Resolved: That this Exchange hereby endorses the policy of open shop for the following reasons:

Because we believe that absolute independence of the individual to work or not to work, to employ or not to employ, is a fundamental principle which should never be questioned or assailed. That on it depends our whole social fabric and business prosperity and that employers and workmen should be equally interested in its defense and preservation.

We believe in the right of individuals or of corporations to deal directly with their employees on the question of wages and conditions of employment without dictation or interference from any person or organization not directly concerned.

We believe that no individual firm or corporation should be discriminated against because of membership or non-membership in any organization.

We believe in organization along the proper lines but are opposed to strikes, boycotts or any and all forms of intimidation or interference with the personal liberty granted by our form of government.

We believe that no two men are created alike and that no standard can be set as a day's work. That there should be no limitation as to the amount of work a man shall perform other than the ability of the man himself and no limitation should be placed on the use of machinery, tools or material and no restriction as to the employment of foremen or apprentices.

We believe the principle of absolute closed shop is contrary to the principles of free government and conflicts with the rights and traditions of American citizenship. We are convinced it deprives the individual workman of all incentive to excel in his chosen calling and is productive of serious loss in time and output.

For these reasons and many more which might be enumerated, we are unalterably opposed to a closed shop policy and pledge ourselves herewith to support the principle of open shop and to maintain in so far as it is possible open-shop conditions in the building industry."

The following list of concerns, and groups are now operating 'open shop" in Buffalo: The entire clothing industry, the entire building trades, the eleven principal hotels of the city, all the principal restaurants and cafes, the entire street railway system, all the mammonth grain elevators, every machine shop of any consequence.

In addition to the above, the following organizations composed of business men and women have endorsed and promised support to the open-shop movement: Chamber of Commerce, Employers' Association, Rotary Club, Kiwanis Club, Conopus Club, Buffalo Federation of Women's Clubs.

Trade Market Letters

NEW YORK

During the summer sales were at a low ebb, with a minimum of inquiries for new equipment. Recently, there has been an improvement, but good business can hardly be expected until after election. Machine-tool manufacturers and dealers are receiving more inquiries, but many are for future requirements. Plants contemplating additional equipment are asking for estimates, but are not closing orders as yet. However, despite the small business transacted in heavy equipment, there is a large demand for taps and dies, milling cutters, small drills and all tool attachments.

The period of little buying activity has enabled the manufacturers to catch up with past orders on file and consequently deliveries have improved greatly.

The railroads in the Chicago territory have been asking for a number of machine tools of all types, but the Eastern roads are still absent from the New York market. Recently, however, several tools were purchased by the Pennsylvania and the New York, New Haven & Hartford Railroads. The New York Central is reported to have a large list in preparation which will be released shortly.

The only feature of interest in the export market is the requirements of the South American railroads. The railroads of northern Brazil will buy through their agents, Costa, Campos & Malta, of Sao Paulo, Brazil, about $1,000,000 worth of rolling stock, including much machine tool equipment. Nelson Malta is now in New York arranging for the placing of this business.

CLEVELAND

The action of the Ford Motor Co. in reducing its prices 30 per cent for cars and trucks has become the chief subject of discussion in the machinery and machine-tool trade here. With business virtually at a standstill for the last three months, still greater uncertainty as to the immediate future confronts the industry, leading machine-tool interests admit. The most significant development of the last few days is the difference in opinion as to what the price trend for equipment will be.

Some manufacturers and distributors here admit that the trade is in for a

reaction in price. Still others assert, and these are mostly manufacturers, that there is no reduction in price in sight.

The latter point to the fact that machinery equipment has advanced no better than 100 per cent above pre-war prices. They consider these increases modest, as compared to many other lines, and also because raw material that formerly was bought for 3 cents a pound now commands a price of 10 cents, while wages alone have doubled in cost to the producer. Moreover, these manufacturers point out that the large equipment manufacturer cannot go into quantity production as does the automobile manufacturer for instance, which also cuts down the chance for lowering overhead.

Whether price reduction would have any effect upon the industry, in stimulating demand, is doubtful at this time. The fact of the matter is there is hardly a house in the Cleveland district that reports doing any business.

Small tools alone seem to be wanted —arbor presses, broaching machines, twist drills, attachments, auxiliary parts. Punching and shearing equipment demand is below normal. Fewer automatic-machine orders are being taken than at any time in the last four years. Drilling-machine demand is only fair. With general manufacturing slowed down, most firms here are turning their attention to the railroads.

Against this uncertainty comes the announcement that at least five large firms here have started to expand their operations.

CHICAGO

Prevailing quiet in general business conditions has extended to the machinery industry, to the extent that new business is probably about 60 per cent of the average established for the first half of the year. The delivery of long expected machines on back order continues and is of sufficient volume to keep sales accounts of good volume. Some cancellations of moment have occurred, principally in orders to the automobile trade, and while such cancellations have, in the case of dealers depending largely on this line of industry, amounted to a large figure, in no case has it seriously inconvenienced any one.

One other feature which right now tends to discourage buying is a feeling of uncertainty in regard to the immediate future of his own business on the part of the prospective buyer. Here in Chicago the feeling is that the present price-cutting wave will not spread to disastrous proportions and that its effect may be such as to stimulate buying and put all manufacturing on a thoroughly sound basis.

The railroads present an encouraging feature for the machine-tool industry. Several large lists on which no buying has been done are still out and it is known that requirements yet unlisted amount to very considerable figures. Rehabilitation of the railroad shops must proceed, almost regardless of general business conditions, and this should be a prolific source of business in the near future. Current booking of new business has been too small in the past week to note demand for various definite lines.

Collections are fair. Effort is required to keep money coming in when due, but an encouraging feature is that a reasonable amount of effort is almost always productive of results.

The Future Course of Business

Curtailment of manufacturing and merchandising activities was inevitable while price changes were radical in character. On the other hand, slowly declining prices require that business be carried on cautiously with careful thought to the long future, but do not preclude sane and conservative operations. Unwillingness to face the facts in the hope of a return to another period of rapidly rising prices, and failure to admit that a new working basis must be found, not only react on the individual interests involved, but on the entire business community. Fortunately, the facts have been recognized by many interests, but in some lines failure to do so is handicapping business.

The United States is in a more favorable position than any other country in the world. If a mutual basis for transactions is found in the immediate future, labor will be kept reasonably well employed, and manufacturing, commercial and financial operations will be maintained at a healthy level. Delay in finding such a mutual basis is not only unwise but it might well result in entirely unnecessary industrial, financial and social disorganization.

INTERNATIONAL CONDITIONS

The condition now prevailing in the United States of declining prices and of consequent hesitation on the part of the buyer, whether he be manufacturer or ultimate consumer, prevails in every important country of the world. The British textile industries have felt not only a slackened domestic demand, but the effects of curtailed buying in distant markets, especially India. The boot, shoe and leather industries of the United Kingdom are now in a state of stagnation. Extreme dullness in the main commodity markets is reported from Constantinople. Business in South Africa is likewise reported as dull. The Japanese situation is a matter of common knowledge. Ports as widely scattered as the Piraeus and Barranquilla are congested with goods bought in large quantities at the flood-tide of postwar prosperity. These goods must now be handled on over-burdened railways, in markets disposed to be critical of prices.

If the business hesitation now prevalent in the United States were peculiarly an American condition, a quick return to a condition of activity could be anticipated. An adjustment of international trade, however, will require a long period for its completion. American business must depend primarily on domestic demand, with the expectation of a fluctuating and uncertain foreign demand.

MANUFACTURES

Pig-iron production in August reached the highest point since February, 1920, being 3,147,402 gross tons. Steel ingot output as reported by companies producing a little less than 85 per cent of the total was 3,000,432 tons, the largest amount since March, 1920. The wool manufacture continues to operate on a restricted basis. On Aug. 2, about 50 per cent of wide looms and woolen spindles, 37 per cent of the worsted spindles, and about one-third of the combs and cards were idle.

Curtailment of operations by automobile manufacturers has resulted in a corresponding reduction in the activity of tire manufacturers. The lessened demand for tire fabrics is an important factor in the lessened activity of the cotton mills. Cotton consumption for August was 483,193 running bales, as compared with 525,405 bales for July.—*Commerce Monthly.*

Norton Co. Holds Sale Conference

The Norton Co., Worcester, Mass., held its 1920 sales conference from Sept. 13 to 18. While the conference was held mainly for the promotion of sales, there was much time spent for entertainment. All of Wednesday was devoted to golf, baseball and a sheep bake. On the other days there were dinners, boat races, dancing, etc.

Round-table discussions, practical demonstrations of new machines and talks, kept the conference busy. "Past Accomplishments and Future Possibilities," by Charles H. Norton, contained a clear and interesting analysis of cylindrical grinding problems. The rest of the conference was devoted to company business.

S. A. E. Winter Meetings

The Society of Automotive Engineers will hold three important meetings during the coming winter. The first of these will be a motorboat meeting on Dec. 4, and the second, the annual meeting from Jan. 11 to 13; both of these will be held at New York. The third, the Chicago truck and tractor meeting, will be held on Feb. 2 at the Morrison Hotel.

Catalogs Wanted

The Bedford Steel and Construction Co., Bedford, Ind., would be pleased to receive catalogs on canning machinery, conveying systems, conveyors, tanks, motors, etc., for installation in a large factory.

C. J. Cazole & Sons., 532 Royal St., New Orleans, La., would be pleased to receive catalogs on woodworking machinery.

Frank Cino, 707 Bourbon St., New Orleans, La., would be pleased to receive catalogs on edging machines for galvanized iron.

The Shaw Manufacturing Co., Lynn, Mass., would like to receive catalogs on automatic machinery, turret lathes, drill presses, and machinery suitable for manufacturing small metal products.

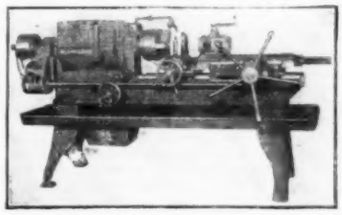
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Lathe, Turret, Geared-Head

Millholland Machine Co., Indianapolis, Ind.

"American Machinist," Sept. 9, 1920

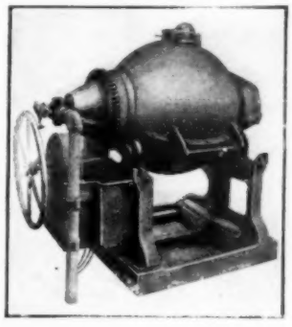


The number of speeds and feeds have been reduced to conform to those more frequently used in actual practice. Specifications: Three sizes, Nos. 3, 4 and 6. Capacities given respectively: Automatic chuck capacity, 1⅝, 1⅞ and 2¼ in. round. Hole in spindle, 1 21/32, 2 1/32 and 2⅝ in. Diameter of swing, over turret slide, 6, 6¾ and 8 in. Length that can be turned, 8, 10 and 14 in. Diameter of swing over bed, 16½, 18¾ and 21¾ in. Diameter of swing over cutoff, 7¼, 9 and 11 in. Countershaft speed, 345, 306 and 283 r.p.m. Net weight, 2,250, 2,900 and 3,500 lb. Weight crated, 2,500, 3,250 and 4,000 lb. Weight boxed, 2,850, 3,500 and 4,600 pounds.

Furnace, Melting, Revolving

Monarch Engineering and Manufacturing Co., Baltimore, Md.

"American Machinist," Sept. 16, 1920

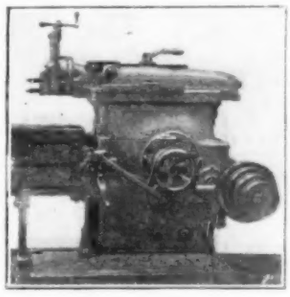


This furnace is a development of the company's Simplex type. It is non-crucible and revolves continuously during melting. It is motor-driven, but a handwheel is provided for a limited amount of hand rotation. The burner is at one end; charging, skimming and venting of gases take place at the other end. The furnace is designed for the melting of metals for general casting work: for disposing of foundry refuse such as slag, grindings and washings, etc. It is also made with double chamber.

Shaper, 16-In. Stroke, Improved

Greenwood & Batley, Ltd., Leeds, England

"American Machinist" (European Edition), Aug. 28, 1920

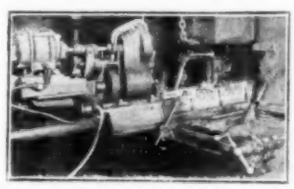


This machine is claimed to have a quick-return motion to the ram of 2 to 1, with a uniform cutting speed; a telescopic screw elevating gear to the table; an improved method of adjusting position of ram; improved slide to table, giving extra long cross traverse, etc. The ram has bearing slides 29 in. long in the column; screw-adjusted strips take up wear. The drive is through a four-speed cone, double gearing and link motion, which gives eight speeds to the ram. The toolholders will take tool steel of 1 x ¾-in. section. The table is 16 x 12 x 14½ in. and has planed T-slots. The machines will keyway a shaft up to 2½ in. in diameter. Power required, 3½ hp.; floor space, 6 ft. 6 in. x 3 ft. 4 in.; net weight, 2,880 lb.

Shaper, Portable, "Damerell"

Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

"American Machinist," Sept. 23, 1920

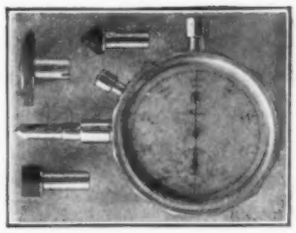


This machine has been designed for truing up drop-hammer parts. It is distinctly a draw-cut shaper, is made in two sizes and is motor driven. It is claimed that the ram will stop in reverse within ⅛ in. without over-travel, allowing the tool to cut close to corners and shoulders. The horizontal feed can be operated either by hand or automatically, while the vertical feed is by hand. Specifications: Small size. Capacity, will plane 48 x 48 in. horizontally and 8 in. vertically. Large size. Capacity, will plane 66 x 66 in. horizontally and 8 in. vertically. Motor, 3 hp. for both sizes. Speed: cutting stroke, 20 ft. per minute; return, 40 ft. per minute.

Indicator, Speed, Hasler

C. H. Boulin, 82 Duane St., New York

"American Machinist," Sept. 16, 1920



This instrument will count speed during a period of three seconds, no watch being needed as the timing is obtained automatically. Pressing the large button at the top starts the mechanism. After running for three seconds this connection is automatically broken, the hand remaining in the reading position. The hands may be brought back to zero by pressing the smaller button. The figures in the outer circle represent revolutions per minute; those in the inner circle, yards per minute. When finding the speed in yards the small wheel shown is used. Speeds up to 10,000 r.p.m. or 1,000 yds. per minute can be counted. The case is made of aluminum and the instrument weighs less than 10 oz.

Boring Machine, Horizontal, Changes in Lambert

Carroll Foundry and Machine Tool Co., Bucyrus, Ohio

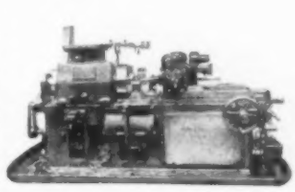
"American Machinist," Sept. 16, 1920

The Lambert horizontal boring machine formerly built by the Lambert Machine and Engineering Co., Cleveland, Ohio, and described on page 270, Vol. 49, of the *American Machinist*. A few changes are announced as follows: The number of feeds of both the boring bar and the table has been increased from sixteen to thirty-two. Extra attachments, including an auxiliary table 8 in. x 4 ft., a circular table with or without worm feed, and a star-feed facing-head having a range from 0 to 3 ft., can be furnished. In addition to the above, the machine can be arranged for motor drive through a silent chain.

Lathe, Turret, Automatic, "No. 5"

Alfred Herbert, Ltd., 54 Dey St., New York

"American Machinist," Sept. 23, 1920

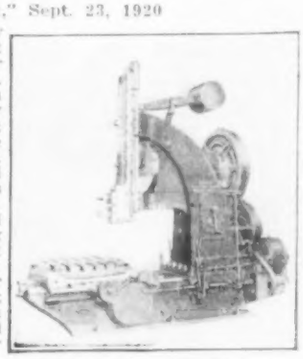


All operations on this machine are automatic, except chucking; the machine stops automatically at the finishing of a piece. Specifications: Maximum swing over bed, 18½ in. Maximum swing between cross-slides, 16 in. From spindle to face of turret; maximum, 34 in.; minimum, 15 in. Spindle to floor, 49½ in. Turret; number of holes, 4; length of working stroke, 13 in. Cross-slides; adjustment along bed, 7½ in., transverse feed, 4½ in.; maximum distance from spindle, 11½ in. Horsepower, 7. Speed of driving pulley, 400 r.p.m. Spindle speeds; automatically changed, 5; substantive, 6; 14 to 411 r.p.m. Feeds, revolutions per inch; turret slide, 16, 27, 48, 64, 83, 110, 144; cross-slides, 40, 68, 122, 163, 212, 280, 366. Floor space, 6 x 12 ft. Approximate weight; net, 8,500 lb.; gross, 10,100 lb. Boxed for export, 340 cu.ft.

Slotting Machine, 20-In.

Jones Machine Tool Works, Media and Edgewood Sts., Philadelphia, Pa.

"American Machinist," Sept. 23, 1920



This machine has a single-pulley drive and may be driven by belt from a two-speed countershaft or by direct connection to a motor. The drive is through a friction clutch and the ram can be quickly stopped by a brake. All operating levers are in duplicate, complete sets being placed on both sides. Quick power-traverse is provided for all feeds. The circular table is provided with an indexing device. The feeds for the cross-slide and the circular table are interlocking so that both cannot be engaged at the same time. Specifications: Speeds; four, 8 to 16 strokes per minute with constant speed motor; or, 8 to 42 strokes per minute with variable speed motor or two speed countershaft. Motor, 10 hp. Floor space, 7 ft. x 12 ft. 7 in.

Clip, paste on 3 x 5-in. cards and file as desired

Trade Catalogs

Machine Tools. Niles-Bement-Pond Co., New York. Over six hundred 9 x 12-in. pages. This book is an excellent example of the better kind of printing. The typography, cuts, press work and paper are all of the best. It is the company's purpose to show the types of machine tools, electric traveling cranes, small tools and gages which it manufactures, and practically 600 pages have been devoted to this. Besides there are halftones of the company's various works, and medals and diplomas awarded it at domestic and foreign expositions.

Standard Buildings. Truscon Steel Co., Youngstown, Ohio. Catalog, pp. 48, 8½ x 11 in. This catalog describes Truscon standard buildings and tells what users of these buildings have to say, gives a wide range of their use, and tells how to select a standard building. It is fully illustrated.

Human Nature and the Factory Building. Truscon Steel Co., Youngstown, Ohio. Catalog, pp. 16, 8½ x 11 in. This catalog is profusely illustrated, showing various plants which are using Truscon daylight sash.

Prepared Joint Electric Cast-Iron Pipe. American Cast Iron Pipe Co., Birmingham, Ala. Booklet, pp. 40, 6 x 9¼ in. The company's prepared joint electric cast-iron pipe is described in this booklet; also its manufacture, and specifications.

Core Drilling. Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. Booklet No. 122, pp. 32, 3½ x 5½ in. The purpose of this booklet is to remind engineers, mining companies and capitalists of the facilities of this company for undertaking mineral prospecting and test boring contracts of all sorts with the Sullivan diamond core drills.

Machine for Setting Adjustable Snap Gages. Prospectus No. 256. Société Genevoise D'Instruments de Physique, Geneva, Switzerland. Golden Co., 405 Lexington Ave., New York, U. S. agent. Illustrated circular describing machine for setting adjustable snap gages. The accuracy of setting made on the machine is within 0.0001 inch.

Ryerson Machinery Quarterly. Joseph T. Ryerson & Son, Chicago, Ill. This is a sixty-four page book giving condensed information covering the Ryerson line of machinery and equipment. While not intended as a complete Ryerson machinery catalog, each issue endeavors to display a representative line of equipment including one or more machine tools of each of the various classes with complete description and specifications.

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES, DURING JULY, 1920
METAL-WORKING MACHINERY

Countries	Lathes 491	Other Machine Tools 492	Sharpening and Grinding Machines 493	All Other 495
Belgium	$5,502	$30,633	$10,748	$17,702
Denmark		3,808	550	1,193
Finland	2,023	50	.....	11,852
France	67,767	115,115	72,809	722,943
Greece		5,612	90	.....
Italy	14,452	23,715	14,248	.....
Netherlands	3,050	18,854	1,075	1,350
Norway		3,017	1,487	1,004
Poland and Danzig	.....	.....	3,429	.....
Portugal			.....	200
Roumania	28,136	401	.....	4,249
Russia in Europe	.....	.....	.....	2,700
Spain	16,354	4,873	5,004	18,412
Sweden	1,554	14,659	6,094	9,996
Switzerland		2,232	1,802	400
England	149,846	198,046	153,162	422,739
Scotland		9,578	100	2,733
Ireland	.....	.....	.....	873
Canada	69,162	174,931	36,517	268,043
Costa Rica		21	.....	.....
Guatemala	4,473	361	15	.....
Honduras	8,939	274	.....	75
Nicaragua		6	.....	.....
Panama		697	1,085	.....
Salvador	175	65	73	45
Mexico	20,238	10,016	1,973	12,211
Newfoundland and Labrador		15	.....	1,275
Barbados		40	111	.....
Jamaica		320	500	2,538
Trinidad and Tobago		67	.....	.....
Cuba	8,925	21,475	1,238	6,021
French West Indies		175	.....	.....
Dominican Republic	90	97	32	.....
Argentina	6,767	17,598	385	12,951
Bolivia		950	2,154	.....
Brazil	281	14,268	1,512	70
Chile	5,734	999	274	8,941
Colombia	525	1,233	10	2,167
Ecuador		333	.....	.....
British Guiana	.....	.....	19	.....
Peru	4,430	2,535	2,157	8,728
Uruguay		399	14,860	.....
Venezuela		184	883	3,161
China	19,531	7,886	8,008	869
Kwantung	.....	.....	.....	110
Chosen			252	615
British India	14,360	112,114	6,406	92,467
Straits Settlements	5,927	273	345	.....
Other British East Indies	1,855	17	254	.....
Dutch East Indies	7,896	4,678	2,080	9,017
Hongkong	2,686	6,510	40	1,271
Japan	57,081	76,792	34,031	132,995
Turkey in Asia	.....	.....	228	.....
Australia	1,681	10,395	4,042	16,570
New Zealand	3,664	9,755	1,364	794
French Oceania	.....	.....	46	2,089
Philippine Islands	7,456	5,070	383	7,087
British West Africa	.....	.....	.....	600
British South Africa	605	738	3,651	14,041
Canary Islands	35	.....	.....	.....
British East Africa	.....	450	.....	.....
French Africa	.....	2,407	403	.....
Morocco	.....	337	.....	.....
Portuguese Africa	.....	.....	317	.....
Egypt	975	.....	.....	.....
Total	542,175	915,074	396,246	1,823,097

New Publications

Spot and Arc Welding. By C. H. A. Hornor. Two hundred ninety-six 5¼ x 7¾-in. pages, 61 illustrations, 20 tables. Bound in dark blue cloth boards. Published by J. B. Lippincott Co., Philadelphia and London.

This book deals largely with spot and arc welding as applied to ship work. Some interesting tables are given showing tests on spot welded ship plate. The appendix contains lessons in arc welding of use to beginners.

The various chapters deal with materials, electric-welding systems, spot welding, demonstrations of heavy spot-welding, general applications of arc welding, discussions on arc welding, the arc welder, the all-welded ship, theories of electric welding.

These chapters are followed by appendixes I to VII.

Grundlagen des Kunstfluges. The Technic of Flight. Fundamental principles of the art of flying. By Professor Arthur Pröll. 322 pp., 5½ x 9 in.; 95 illustrations and diagrams. Published by R. Oldenbourg, Munich and Berlin, Germany.

The book, which contains an adequate treatment of the theory of flight, is written not only for the student of aeronautical science but has its value also in the hands of a designer. A good deal of attention is given by the author—while discussing the important mathematical formulas and laws—to pointing out their practical usefulness, thereby placing many valuable suggestions in the hands of airplane designers.

The book is divided into fifteen chapters, of which: The horizontal potential current; aerodynamics of the profile air currents; action of the air whirls on supporting planes and their relative influence; representation by means of curves of the elements of flight; practical suggestions for the design of airplanes and experimental flight are the features of the work. The book is well illustrated and is a valuable addition to the literature of aeronautical engineering.

Forthcoming Meetings

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, up to Oct. 9. It started Oct. 4. C. E. Hoyt, 1401 Harris Trust Buildnig, Chicago, Ill., is secretary.

The 1920 New York Electrical Show, Grand Central Palace, held from Oct. 6, will end on Oct. 10.

The Standardization Conference of the National Association of Purchasing Agents will be held at the Congress Hotel, Chicago, Ill., on Oct. 9.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The Federated American Engineering Societies will hold its first meeting at the Hotel New Willard, Washington, D. C., on Nov. 18 to 20 inclusive.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association's offices at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

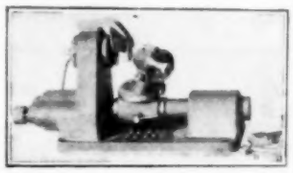
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Grinding Machine, Cutter, Engraving

George Gorton Machine Co., Racine, Wis.

"American Machinist," Sept. 23, 1920



The abrasive-wheel is direct-driven by a small high speed motor incorporated in the machine. The motor is of the universal type and can be used with either d.c. or a.c. current. Motors can be furnished for any desired voltage. The tool to be ground is supported in a sleeve which holds it identically as it is held in the engraving machine, the sleeve being provided with indexing means for determining the cutting angle. The tool carrier has a graduated swivel-base so that the tool can be presented to the wheel at any angle desired. The regular equipment includes an attachment for grinding the point of the stylus used in connection with the master plate on the engraving machine, also a holder for the truing diamond. Weight, 75 lb.

Pyrometer, Optical, "Wedge"

Rohde Laboratory Supply Co., 17 Madison Ave., New York.

"American Machinist," Sept. 23, 1920

The instrument can be used whenever the object to be examined shows a distinct coloration due to heating. It is claimed that size or distance of the object does not affect the reading. The instrument contains an achromatic telescope, the objective of which focuses the image of the heated body on a movable, dark-glass prism. The observer views the image on the prism through the eye piece, exterior light being shut out by a shield. The prism, which can be moved across the field of vision by means of a rack and pinion, is moved until the proper thickness of glass is interposed to just shut off the light emitted by the heated body. At this point, when the image disappears, the temperature of the heated body can be read under the pointer on the scale of the instrument. The pyrometer can be furnished in three standard types to cover ranges of 400, 650 or 800 deg. C.

Drilling Machine, 20-In., "No. 5"

Frontier Machine Tool Co., Inc., 128 Lakeview Ave., Buffalo, N. Y.

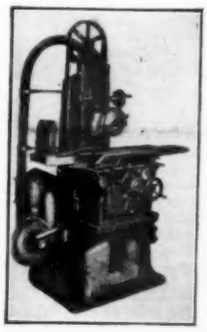
"American Machinist," Sept. 23, 1920

An important feature of this machine is the double column. The rear column is intended to counteract the effect on the column of the upward thrust on the spindle. Specifications: Table diameter, 17 in. Capacity up to 1½-in. drill. Distance between table and spindle, 26 in. Distance between spindle and base, 38½ in. Vertical travel of table on column, 24 in. Hole in spindle, No. 3 Morse taper. Number of speeds, 8, with use of back gear. Feeds: 0.005, 0.015, and 0.030 in. per revolution. Floor space, 15 x 48 in. Weight; net, 635 lb; crated, 700 lb.; boxed for export, 950 pounds.

Exhauster Attachment, for Surface Grinding Machines

Abrasive Machine Tool Co., East Providence, R. I.

"American Machinist," Sept. 23, 1920

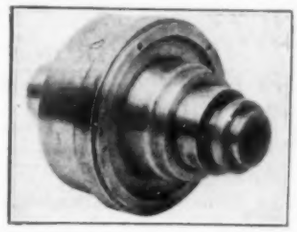


The exhauster is equipped with S-K-F ball bearings and aluminum fan running at 4,000 r.p.m. It is connected with the aluminum dust collector on the wheel hood by means of a large flexible wire-insert rubber suction tubing. The wheel dust is drawn in through the flexible tubing, and forced into the centrifugal drum attached to the rear of the machine, where the dust is separated and deposited at the bottom of the cone. The claim is made that this exhauster is more economical in many cases than a central system because it is not running when the machine is idle.

Clutch, Friction, Duplex

A. Mill Clutch Co., 2116-20 Colerain Ave., Cincinnati, Ohio.

"American Machinist," Sept. 23, 1920

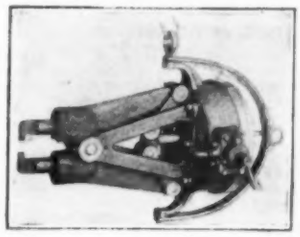


Contact is made by means of both an expansion friction ring and two side plates, so that all of the surface available for friction inside of the case is utilized. When the clutch is operated, the ring engages first and then the side plates, thus securing a jerkless grip on the rotating shaft. The case is said to be perfectly dustproof and capable of holding oil for a long time. The clutch is especially adapted to high speeds, can readily be engaged and disengaged and is easily adjusted for wear.

Riveter, Close-Corner

Baird Pneumatic Tool Co., Kansas City, Mo.

"American Machinist," Sept. 23, 1920

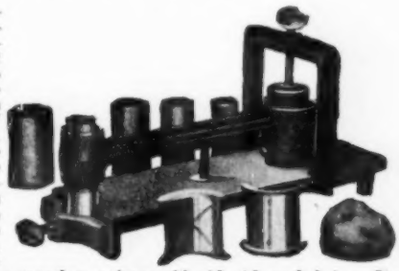


This riveter is a special machine and, as its name implies, is intended for work in extremely close corners where riveting by a hand hammer is impossible. It is claimed that in this riveter, a pressure of 50 tons is exerted on the dies and that ⅞-in. rivets can be driven cold.

Babbitting Fixture

O. A. Bremer Co., 222 Division St., Burlington, Iowa.

"American Machinist," Sept. 23, 1920

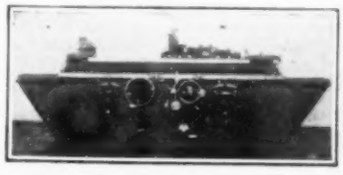


This babbitting fixture is used for rebabbitting bearings of connecting rods up to 12 in. in length, center to center, and any bore from ½ to 2½ in. It is intended for the use of the garage repair shop. The bearings may be babbitted either while in the rod or when removed. The claim is made that very little scraping is required to make a perfect fit on the crankshaft. This fixture is supplied with four wooden arbors, 1¼, 1½, 1¾ and 2 in. Its shipping weight is 15 lb. The same concern manufactures a special metal-arbor fixture for Ford connecting rods, the weight being 8 lb.

Grinding Machine, 10-In., Type "B"

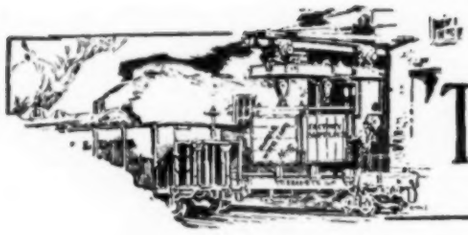
Norton Co., Worcester, Mass.

"American Machinist," Sept. 23, 1920



The manufacturer announces a grinding speed in this machine 200 per cent faster than he has attained before. The machine is self-contained. The drive is from a 15-hp. motor mounted on the machine. The machine swings an 18-in. wheel with a face width of 2¾ in., though wheels 6 in. wide may be used. The spindle runs 1,300 r.p.m. The table traverse has six work speeds ranging from 10 to 36 ft. per minute and a separate very slow speed for wheel truing. The headstock has six rotative speeds ranging from 53 to 167 r.p.m. The floor space required is 16 ft. 3 in. x 7 ft. 2 in. and the extreme height is less than 5 ft. The approximate net weight complete, with motor is 11,000 lb. The machine, as built at present, will swing work up to 10 in. in diameter and will take 72 in. between centers.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$46.50	$30.35
Northern Basic	51.30	27.55
Southern Ohio No. 2	48.50	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	57.12	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	52.10	35.20
BIRMINGHAM		
No. 2 Foundry	42.00@45.00	29.25
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	51.25	29.00-30.00
Virginia No. 2	50.00*	33.10
Basic	51.00†	26.75
Grey Forge	48.00*	26.75
CHICAGO		
No. 2 Foundry local	47.00	26.75
No. 2 Foundry, Southern	48.67	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	49.56	28.15
Basic	48.96	27.15
Bessemer	51.96	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.58	$4.47	$3.47	$3.44	$3.37	$4.08	$3.47
Soft steel bars	4.73	4.62	3.37	4.50	3.27	3.98	3.37
Soft steel bar shapes	4.73	4.62	3.37	.....	3.27	3.98	3.37
Soft steel bands	6.43	6.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.78	4.67	3.67	3.64	3.57	4.28	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.23@8.00	4.57	8.10	7.90
No. 12	3.60-7.05	7.28@8.05	4.62	8.15	7.95
No. 14	3.65-7.10	7.33@8.10	4.67	8.20	8.00
No. 16	3.75-7.20	7.43@8.20	4.77	8.30	8.10
Black					
Nos. 18 and 20	4.20-6.20	8.41@9.80	5.30	8.70	7.13
Nos. 22 and 24	4.25-6.25	8.46@9.85	5.35	8.75	7.18
No. 26	4.30-6.30	8.51@9.90	5.40	8.80	7.23
No. 28	4.35-6.35	8.61@10.00	5.50	8.90	7.33
Galvanized					
No. 10	4.70-8.00	8.91@11.50	5.75	9.00	8.25
No. 12	4.80-8.10	9.01@11.50	5.85	9.10	8.30
No. 14	4.80-8.10	9.01@11.60	5.85	9.10	8.45
Nos. 18 and 20	5.10-8.40	9.26@11.90	6.15	9.40	8.75
Nos. 22 and 24	5.25-8.55	9.41@12.05	6.30	9.55	9.15
No. 26	5.40-8.70	9.56@12.20	6.45	9.70	9.30
No. 28	5.70-9.00	9.86@12.50	6.75	10.00	9.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.36	$5.90	$6.00
Flats, square and hexagons, per 100 lb. base	6.86	6.40	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL — Base prices in cents per pound F.O.B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots			42
Malleable nickel sheet bars			47
Hot rolled rods, Grades "A" and "C" (base)			60
Cold drawn rods, grades "A" and "C" (base)			72
Copper nickel ingots			45
Hot rolled copper nickel rods (base)			54
Manganese nickel hot rolled (base) rods "D" — low manganese			62
Manganese nickel hot rolled (base) rods "D" — high manganese			67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f.o.b. New York: ⅛, 8½c. per lb.; ¼, 8c.; ⅜ to ½, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.15
Spring steel (light)	10.00	11.00	12.50
Coppered bessemer rods	9.00	8.00	6.86
Hoop steel	6.68	6.50	5.43
Cold-rolled strip steel	12.50	8.25	11.00
Floor plates	6.91	6.00	6.88

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛ to 3	54-57½%	41½-44%	⅛	15½-25½%	+1½-11½%
			¼	19½-29½%	1½-11½%
			⅜ to 1¼	24½-34½%	8 -18½%

LAP WELD

2	47 -50½%	34½-38%	1¼	.....	.....
2½ to 6	50 -53½%	37½-41%	1½	.....	.....
7 to 12	47 -50½%	33½-37%	2	20½-28½%	6½-14½%
13 to 14	37½-41 %	.....	4½ to 6	22½-30½%	9½-17½%
15	35 -38½%	.....	2½ to 4	22½-30½%	9½-17½%
			7 to 12	19½-27½%	6½-14½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛ to 1¼	52 -55½%	39½-43%	⅛ to 1½	24½-34½%	9½-19½%
2 to 3	53 -56½%	40½-44%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45 -48½%	33½-37%	1¼	.....	.....
2½ to 4	48 -51½%	36½-40%	1½	.....	.....
4½ to 6	47 -50½%	35½-39%	2	21½-29½%	8½-16½%
7 to 8	43 -46½%	29½-33%	2½ to 4	23½-31½%	11½-19½%
9 to 12	38 -41½%	24½-28%	4½ to 6	22½-30½%	10½-18½%
			7 to 8	14½-22½%	2½-10½%
			9 to 12	9½-17½%	5½-+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	38%	22%	39%	30%	54%@40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18.50	19.00	22.50
Tin in 5-ton lots	44.50	49.00	56.50
Lead	8.50	9.50	6.25
Zinc	8.50	8.35	7.60
ST. LOUIS			
Lead	8.00	8.90	6.00
Zinc	7.70@8.05	7.70@8.40	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	29.50	33.50	33.50	34.00	35.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	30.75	29.00	30.50	29.00	26.00
Brass sheets	28.50	28.50	32.00	36.00	33.00	27.00	28.00
Brass pipe	33.00	33.00	36.00	34.00	39.00	34.00	37.00
Solder (half and half) (case lots)	35.00	38.00	45.00	40.50	41.00	38.00	38.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	24.00
New York	27.00	28.00@29.75
Cleveland	27.00	29.00
Chicago	30.00	27.00

SHOP MATERIALS AND SUPPLIES

ZINC SHEETS—The following prices in cents per pound are f.o.b mill + less 8% for carload lots 12.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.25	9.50
Chicago	9.00	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	15.00	17.00	14.00	15.00
Copper, heavy, and wire	14.00	16.00	13.50	14.50
Copper, light, and bottoms	12.50	14.00	12.00	13.00
Lead, heavy	7.00	4.75	7.00	7.00
Lead, tea	5.00	3.75	4.00	6.00
Brass, heavy	9.50	10.50	10.00	14.50
Brass, light	7.00	7.50	7.00	8.00
No. 1 yellow brass turnings	8.50	10.00	7.50	8.00
Zinc	5.00	5.00	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$33.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	32.00
Chicago	29.00	31.00
Cleveland	34.00	35.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	54.00	70.00	60.00	60.00
Commercial	50.00	50.00	20.50	16.50	15.00	13.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York —		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.30
Cold punched square	+ 6.00	1.50	List net	2.25	+1.15	1.30

Semi-finished nuts, $\frac{5}{16}$ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50-10%
Chicago	40%	50%
Cleveland	50%	60-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	25%	20%
Larger and longer up to 1¼ in. by 30 in.	+ 20%	25%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... list Cleveland ..... $2.00 Chicago $1.90

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York ..... $7.00 Cleveland ..... $4.50 Chicago $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	25%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel $\frac{7}{16}$ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York ..... $6.00 Chicago ..... $5.73 Pittsburgh $4.5

Structural, same sizes:
New York ..... $7.10 Chicago ..... $5.83 Pittsburgh $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$34.00	$36.00	$35.00
Brass	33.00	36.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price quantities from 10-25 lb., extra is 10c; less than 10 lb., add 15-20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ¼-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00-12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13¼	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	3.00	2.50
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.87
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	October 4	September 27	September 20
Prompt furnace	$16.00@$16.50	$17.00@$18.00	$17.00@$18.00
Prompt foundry	17.00@18.50	18.00@20.00	18.00@20.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

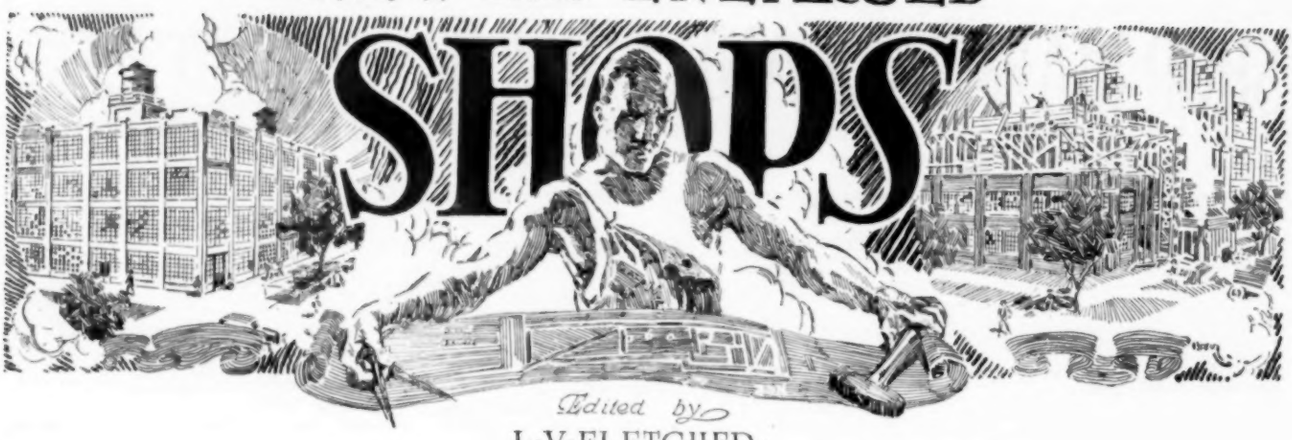
	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots	$1.25	$2.15	$1.45	$2.50	$1.40	$2.37
5-gal cans	1.40	2.30	1.65	2.75	1.65	2.57
1-gal cans (6 to case)	1.45	.....	.....	.....	.....	.....

WHITE AND RED LEAD—Base price per pound:

	— Red —				— White —	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10-2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., Bridgeport — The International Tool and Gauge Co., 706 Howard Ave.—one 6 ft. cornice brake for sheet metal work.

Me., East Baldwin—F. E. Wood—20 to 26 in. double surface planer, about 8 ft. (used).

Mass., Springfield — The Hampden Tool Co., 238 Dwight St.—punch presses.

Md., Baltimore—The Spann Motor Co., 3125 Philadelphia Ave., C. A. Spann, Purch. Agt.—general automobile repair and machine shop tools.

Md., Baltimore — The Union Fish Co., Fish Market—complete equipment for garage and service station.

N. J., Jersey City—The Brady Brass Co., 170 14th St.—one engine lathe.

N. Y., New York (Borough of Manhattan)—The Greyhound Motor Corp., 5 Columbus Circle—machine tool equipment for new automobile plant.

N. Y., New York (Borough of Manhattan)—The Star Metal Box Co., 509 West 19th St.—one lathe with 6 to 8 in. swing.

N. Y., Rochester—The Alent Machine Tool Co., 419 St. Paul St., N. Alent, Purch. Agt.—one boring mill.

N. Y., Rochester—L. Freedman, c/o Selder Co., Probert St.—one medium size planer, one drill press and one milling machine.

N. Y., Rochester—The Harrison Machine Co., 144 Platt St., J. Harrison, Purch. Agt.—one 24 in shaper.

N. Y., Rochester—The L.L.L. and D. Mfg. Co., 263 State St., T. B. Shannahan, Purch. Agt.—one medium size punch press.

N. Y., Summerville—J Pollock, Stop 26—one milling machine.

N. Y., Syracuse—The Crouse Hinds Co., Wolf and 7th Sts.—squaring shear, capacity to cut ¼ in., 120 in. to 127 in. wide throat 18 to 24 in., arranged for motor preferred. Niagara Machine & Tool Wks. preferred. Price f.o.b. Syracuse, N Y.

Pa., Philadelphia—The Reyburn Mfg. Co., 23d and Allegheny Sts.—garage equipment.

Pa., Pittsburgh—The Peerless Fdry. Co., 5602 Baum Blvd.—$1,000 worth of equipment for repairs, including one small drill press, one 14 in. engine lathe and one small shaper.

Pa., Reading—The Daniels Motor Co., 3d St.—machine tools for the Philadelphia plant on Westmoreland St. and Huntingdon Park.

Miss., Lumberton — The Lumberton Saw Mfg. Co.—punches, shears and milling machine for beveling the teeth on a circular saw about 12 x 72 in.

Va., Richmond—E. W. McMinn, 1548 East Cary St.—one lathe and drill press (new or used).

Ill., Peoria—The Bartholomew Co.—one 3 spindle high duty drill press, with compound table, capacity up to 2 in.

Mich., Port Huron—The Amer. Bushings Corp.—one 68N and one 69N Bliss press, geared or flywheel type, or their equivalent.

O., Cleveland—The Sterling Knight Co., Ajax Bldg.—a No. 2 Cincinnati or Brown & Sharpe universal miller with dividing head and all attachments (used).

O., Cleveland—The Waite Taxi and Livery Co., 1618 Walnut Ave.—one 16 in. x 8 ft. lathe and one 16 in. drill press (used).

Wis., Milwaukee — The Breitenbach Machinery Co., 1049 5th St., E. V. Breitenbach, Purch. Agt.—one 30 x 30 x 16 ft. planer, one 24 in. shaper and one medium size miller.

Wis., Milwaukee — The Central Bd. of Purchases, City Hall, W. Callahan, Purch. Agt.—one milling machine, Kearney & Trecker 2B, or equivalent.

Wis., Milwaukee — The C. C. Hendee Brush Co., 493 Bway., C. C. Hendee, Purch. Agt. — special wire working machinery, twisters, borers, shapers, etc.

Wis., Milwaukee—The Milwaukee Pointless Spark Plug Co., 883 27th St., W. J. Fowler, Purch. Agt.—machine tools, including drill presses, lathes, grinders, etc.

Wis., Milwaukee—The Oakland Mfg. Co., 460 27th St. (auto accessories), E. L. Koehler, Purch. Agt.—machine tools, lathes, etc.

Wis., Milwaukee — W. E. Seymour Mfg. Co., 237 Plankinton Arcade, manufacturer of piston rings, W. E. Seymour, Purch. Agt.—
One 12 in. Diamond emery wheel stand.
One No. 1 or 2 Gardner disc wheel grinder.
One Besley 10 x 12 in. 2 wheel grinder.
One 8 x 20 in. Heald rotary grinder.
One Whitney or similar hand miller No. 6.
One Porter or similar 9 x 20 in. cable lathe.
One 10 x 36 in. cylindrical grinder.
One 8 x 20 in. engine lathe.
One No. 2 universal tool grinder.
One 20 in. shaper.
One 6 x 6 in. power saw.
One 24 in. drill press.

Wis., Milwaukee—The Trident Eng. Co., 934 3d St., manufacturer of auto equipment, F. Muldoon, Purch. Agt.—punch press.

Wis., Milwaukee — The Utility Hoist & Mfg. Co., 829 Forest Home Ave., C. Woodin, Purch. Agt.—one large shaper, one medium size milling machine, one small drill press and one lathe.

Wis., Milwaukee—The Winkler Eng. Co., 101 Wisconsin St., W. Reckmeyer, Purch. Agt.—machine tools to manufacture auto engines and machinery.

Minn., Minneapolis—The Minneapolis Advertising Specialty Co., 305 5th St., S., C. J. Marboe, Vice-Pres. and Treas.—one 40 or 42 in. cutting machine (used), also one embossing machine, at least 15 x 18 in. head. Replies should give condition, style and make of machine.

Ont., London—The Ruggles Motor Truck Co.—complete equipment for motor truck plant (new).

Ont., Toronto — Wilson-McGovern, Ltd., Lumsden Bldg.—one 56 or 60 in. x 160 in. grinder for grinding hot mill shear blades.

Ont., Welland—The Canada Foundries & Forgings, Ltd.—drilling and tapping machinery for turnbuckles.

Machinery Wanted

Pa., Philadelphia—The Harrison Safety Boiler Wks., Inc., 17th and Allegheny Sts.—one 15 ton crane, 40 ft. span, direct current (second hand).

Pa., Philadelphia — The C. McCaul Co., Presser Bldg.—equipment for iron foundry.

La., New Orleans — The Great Southern Lumber Co., Whitney Bldg. — paper mill machinery for addition to present plant at Bogalusa, La.

Va., Richmond—E. L. Bass Bros., 1708 Bainbridge St. (woodworking shop), E. L. Bass, Purch. Agt.—one ripsaw and one band saw (new or used).

Va., Richmond—J. E. Gill & Son, 700 Bainbridge St. (auto repair shop, wheelwright), J. E. Gill, Purch. Agt.—one band saw, one ripsaw, one joiner (new or used).

Ill., Chicago—The Unity Equipment Co., 127 North Dearborn St.—crosscut and ripsaw to handle up to 9 in. timbers.

Mich., Owasso—The Amer. Malleable Co.—one 5 ton crane.

Wis., Marinette — The Below Saw Mill Co.—one saw and one planer.

Wis., Milwaukee—The Red Star Yeast & Product Co., 27th and St. Paul Sts.—hoppers.

Minn., Minneapolis — J. H. Brown Co., 511 3d St., S. (woodworkers), J. H. Brown, Purch. Agt. — woodworking machinery (second-hand).

Okla., Miami—L. B. Drake, Pres. of the School Bd., 519 Mining Exch. Bldg.—mining machinery.

B. C., Vancouver—The Dock Comn.—several traveling cranes.

Ont., Doon—The Doon Twine, Ltd.—special machinery for the manufacture of twine and cordage.

Ont., London—The Service Motor Truck Co., Wabash, Ind.—special machinery and equipment for making parts for motor trucks.

Metal Working

NEW ENGLAND STATES

Conn., Hartford—The Arrow Electric Co., 99 Hawthorne St., plans to alter its 3 story factory on Capitol Ave. Buck & Sheldon, Inc., 60 Prospect St., Engrs.

Conn., Naugatuck—The Rubber Regenerating Co., Elm St., has awarded the contract for altering several buildings and constructing a 1 story addition to its machine shop. Estimated cost, $50,000

Conn., New London — T. Ragowese, 721 Bank St., has awarded the contract for the construction of a 2 story, 40 x 55 ft. garage and service station on Bank St. Cost to exceed $25,000.

Conn., Torrington—The Torrington Mfg. Co., 70 Franklin St., manufacturer of machinery, has awarded the contract for altering its pattern shop and tool room, etc. Estimated cost, $5,000.

Conn., Waterbury — P. Miller, 27 West Clay St., will soon award the contract for the construction of a 2 story, 25 x 50 ft. garage on Clay St. Estimated cost, $15,000. H. F. Wenzell, 6 Glen Ridge Ave., Archt.

Mass., Athol—The Union Twist Drill Co. has awarded the contract for the construction of a 1 story, 60 x 112 ft. factory for the manufacture of twist drills. Estimated cost, $50,000.

Mass., Charlestown—The Boston Elevated Ry. Co., 108 Massachusetts Ave., Boston, will build a 1 story, 40 x 65 ft. garage on Main St., here. Estimated cost, $15,000.

Mass., Everett—L. Albaum, 49 Malden St., will build a 1 story, 70 x 90 ft. garage on School St. Estimated cost, $22,000.

Mass., Holyoke—T. J. Lynch, 206 High St., has awarded the contract for the construction of a 2 story, 60 x 75 ft. garage on Bowers St. Cost between $40,000 and $50,000.

Mass., Shawsheen — The Amer. Woolen Co., 245 State St., Boston, has awarded the contract for the construction of a 2 story, 64 x 130 ft. garage here. Estimated cost, $80,000.

Mass., Somerset—The Somerset Stove Fdry. Co. will soon award the contract for the construction of a 1 story foundry. Estimated cost, $50,000. N. S. Chase, Borden Blk., Fall River, Engr.

Mass., Springfield—The Forging Service Corp., 318 Main St., will build a 1 story, 45 x 125 ft. forge shop on Switzer Ave. Estimated cost, $25,000.

Mass., Springfield—The Natl. Automobile Parking Co., 15 Temple St., plans to construct a 5 story, 100 x 200 ft. garage, repair shop and storage building on Dwight St. Estimated cost, $500,000. T. W. Carman, Vice-Pres.

R. I., Woonsocket—The Amer. Wringer Co., 91 Social St., has awarded the contract for the construction of a 2 story, 66 x 180 ft. mechanical roll building on Pond and Clinton Sts. Estimated cost, $100,000. Noted Sept. 24.

Vt., Brattleboro—S. A. Smith Mfg. Co. will build a 2 story, 25 x 100 ft. factory for the manufacture of toys. Estimated cost, $25,000.

Vt., Northfield—The Cross Bros. Garage Co. has awarded the contract for the construction of a 1 and 2 story, 60 x 150 ft. garage on Main St.

MIDDLE ATLANTIC STATES

Md., Baltimore — The Amer. Can Co., Maryland Trust Bldg., will soon award the contract for the construction of a 4 story can factory on Hudson and Boston Sts. Estimated cost, $500,000. C. Z. Treis, 120 Bway., New York City, Engr. Noted Sept. 2.

Md., Baltimore—The Kennedy Corp., Fidelity Bldg., manufacturer of iron castings, etc., has awarded the contract for the construction of a 1 and 2 story addition to its iron foundry on Charles and Wells Sts. Estimated cost, $100,000. Noted Sept. 24.

Md., Baltimore—The Spann Motor Co., 3125 Philadelphia Ave., will soon award the contract for the construction of a 2 story 150 x 167 ft. machine shop, service building and automobile repair works on Ellwood and Philadelphia Aves. Estimated cost, $25,000.

Md., Baltimore—The Union Fish Co., Fish Market, will build a 3 story, 60 x 90 ft. service station and garage at 1419-21-23 Maryland Ave. Estimated cost, $60,000. I. W. Snitzer, Pres.

Md., Cumberland—The New Detroit Car Corp., Detroit, Mich., has taken options on 1,250 acres near here, and plans to build a factory for the manufacture of 4 cylinder touring car of high power.

N. J., Newark—The National Lock Washer Co., 65 Johnson St., is having plans prepared for a large addition to its plant. Fletcher & Thompson, Inc., 1089 Broad St., Bridgeport, Conn., Engrs. and Archts.

N. J., Pennington—The Peerless Insulating Wire & Cable Co. plans to build a 1 story, 40 x 60 ft. addition to its wire plant. Estimated cost, $40,000. W. Kidde, 145 Cedar St., New York City, Archt.

N. Y., New York (Borough of Brooklyn) —The Bay 23d St. Constr. Co., 181 Bay 17th St., will build a 1 story, 120 x 150 ft. garage on 18th Ave. near Cropsey Ave. Estimated cost, $45,000.

N. Y., New York (Borough of Brooklyn) —G. F. Lamb, 21 Park Row, New York City, will build a 1 story, 100 x 200 ft. garage on Pacific St. and Buffalo Ave. Estimated cost, $40,000.

N. Y., New York (Borough of Brooklyn) —The Perri Contg. Co., 17 Spencer St., will build a 1 story, 40 x 50 x 100 x 190 ft. garage on Flushing Ave. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn) —W. R. Rosenstein, 204 New Lots Rd., will build a 2 story, 100 x 100 ft. garage on Lawrence St. near Willoughby Ave. Estimated cost, $75,000.

N. Y., New York (Borough of Brooklyn) —C. Skolnick c/o P. Steigman, Engr. and Archt., 690 Bway., will build a 1 story, 75 x 100 ft. garage on Park Ave. and Throop St. Estimated cost, $40,000.

N. Y., New York (Borough of Manhattan)—W. S. Barrington, 191 9th Ave., has awarded the contract for the construction of a 4 story, 100 x 200 ft. garage and service station on 13th Ave Estimated cost, $200,000.

N. Y., New York (Borough of Manhattan) —H. Birdsall, 182 West St., will alter and build a 1 story, 100 x 110 ft. top addition to his garage on Thompson Ave. Estimated cost, $60,000.

N. Y., New York (Borough of Manhattan) —The Dept. of Plants and Structures, Municipal Bldg., has awarded the conrtact for the construction of a 1 story, 100 x 120 ft. garage on Delancy St. Estimated cost, $50,000.

N. Y., New York (Borough of Manhattan) —The G. Dose Eng. Co., 43 West 27th St., will build a 2 story, 100 x 200 ft. garage and service station at 529 West 55th St. Estimated cost, $175,000.

N. Y., New York (Borough of Manhattan) —The Exide Battery Co., has awarded the contract for the construction of a 2 story, 115 x 125 ft. garage on Spring and Clark Sts.

N. Y., New York (Borough of Manhattan) —The Exide Battery Co., 101 West End Ave., has awarded the contract for the construction of a 2 story, 100 x 100 ft. garage on 55th St. and 3d Ave.

N. Y., New York (Borough of Manhattan) W. J. Flynn, 11 East 167th St., will build a 1 story, 100 x 175 ft. garage on Cromwell Ave. near 170th St. Estimated cost, $80,000.

N. Y., New York (Borough of Manhattan) —The Fort Lee Ferry Garage Co., 619 West 129th St., New York City, will build a 2 story, 120 x 260 ft. garage on Moylan Pl. Estimated cost, $350,000.

N. Y., New York (Borough of Manhattan) —A. J. Goodwin, 332 East 35th St., will build a 2 story, 75 x 100 ft. garage. Estimated cost, $60,000.

N. Y., New York (Borough of Manhattan) — Scharlin Bros., 238 East 20th St., have awarded the contract for the construction of a 4 story, 50 x 100 ft. garage at 148 East 24th St. Estimated cost, $100,000.

N. Y., Rochester — The Rochester Castings Corp. is having plans prepared for the construction of a 1 story, 280 x 1,000 ft. brass foundry. J. F. Ancona, 307 Cutler Bldg., Archt.

Pa., Johnstown—The Cambria Steel Co is having plans prepard for the construction of a 3 story, 60 x 170 ft. sintering plant. Estimated cost, $300,000. A. S. McKee Co., 2422 Euclid Ave., Cleveland, O., Engrs.

Pa., Philadelphia—The Fleischman Yeast Co., 701 Washington St., New York City, will soon award the contract for the construction of a 3 story, 36 x 124 ft. garage at 1707 Vine St., here. Private plans.

Pa., Williamsport—The McCormick Motor Cars Co. plans to build a 4 story, 102 x 196 ft. garage, to include a repair room, service station, etc., on 3d and Hepburn Sts. Estimated cost, $250,00. Turner Constr. Co., 1713 Sansom St., Philadelphia, Pa., Archts.

SOUTHERN STATES

Va., Richmond—The Tredegar Iron Wks., 5th St., plans to rebuild its pattern and machine shop which was recently destroyed by fire. Estimated loss, $250,000.

MIDDLE WEST

Ill., Chicago—The C. G. Stevens Iron Wks., 33 South Jeffrson St., plans to build a 1 story warehouse, garage and power house on Western Ave. and 45th St. Estimated cost, $75,000.

Ill., East St. Louis—The East St. Louis Locomotive and Car Co. plans to build the 1st unit of its plant on 150 acre site, here. Estimated cost, $50,000. R. W. Crawford, 5483 Ellis Ave., Chicago, Pres.

Ind., Frankfort — The Stewart Wire Wheel Co. has had plans prepared for the construction of a 2 story, 60 x 85 ft. factory and office building. Estimated cost, $75,000. R. Leonard, 505 Peoples Life Bldg., Archt.

Ind., Indianapolis — The Bd. of School Comrs., Meriden and Ohio Sts., will soon award the contract for the construction of a 2 and 3 story, 250 x 400 ft. manual training shop, for school on East Michigan St. Estimated cost, $225,000. Snider & Rotz, 703 Merchants Bank Bldg., Engrs.

Ind., New Haven—The Visible Pump Co., 402 Central Bldg., Fort Wayne, plans to build a factory for the manufacture of gasoline and oil pumps. Estimated cost, $100,000.

Mich., Owasso—The Amer. Malleable Co. has awarded the contract for the construction of a 1 story factory. Estimated cost, $150,000.

O., Cleveland—The Amer. Register Co., Payne Ave. and East 37th St., has awarded the contract for the construction of a 1 story, 14 x 43 ft. addition to its factory. Estimated cost, $10,000.

O., Cleveland—The Barnberger Reinthal Co., 2621 East 9th St., will soon award the contract for the construction of a 1 story, 31 x 78 ft. garage on Kinsman Rd. and East 70th St. Estimated cost, $15,000. Christian Schwarzenberg & Gaede Co., 1900 Euclid Ave., Archts.

O., Cleveland—The City Iron Wks., 2921 East 72nd St., will build a 1 story, 42 x 80 ft. addition to its factory. Estimated cost, $12,000.

O., Cleveland—The Globe Motors Co., c/o F. W. Staffeld, Secy., State Bank & Trust Co., West 65th St. and Detroit Ave., plans to build a 1 story auto factory to cover 18,000 sq.ft. floor space on Euclid Ave. and Chardon Rd. Estimated cost, $300,000.

O., Cleveland—A. Holbeck, c/o A. D. Cefert, Archt., Permanent Bldg., is having plans prepared for the construction of a 1 story, 74 x 138 ft. garage on East 93d St. and Woodland Ave. Estimated cost, $50,000.

O., Cleveland—The Ko-Ko-Mar Co., 3007 West 47th St., has awarded the contract for the construction of a 1 story, 26 x 61 ft. garage. Estimated cost, $10,000.

O., Cleveland—The Vita Mfg. Co., 7500 Quincy Ave., manufacturer of electrical instruments, plans to build a 2 story factory addition. Estimated cost, $25,000. W. E. Sherbonely, Pres.

Wis., Oconomowoc—W. S. King is having plans prepared for the construction of a 1 story, 90 x 160 ft. garage, etc., on Main St. Parkinson & Dockendorff, Linker Bldg., La Crosse, Archts.

WEST OF THE MISSISSIPPI

Ia., Griswold—W. J. Grennell will build a machine shop.

Mo., St. Louis — The Missouri Car Co. plans to construct a street car plant for building and assembling one-man street cars. Estimated cost, $250,000. L. Viterbo, Wright Bldg., Dir.

Okla., Oklahoma City — The Missouri, Kansas & Texas Ry., Ry. Exch. Bldg., St. Louis, Mo., has awarded the contract for the construction of railroad shops and a round house here. Estimated cost, $150,000. Noted Sept. 9.

WESTERN STATES

Ont., Listowel—H. B. Morphy plans to build a factory for the manufacture of disc wheels for automobiles. Estimated cost, $150,000.

Ont., London—Beatty Bros., York St., manufacturers of instruments plan to build a 2 story, 50 x 400 ft. factory on Chelsea Green. Estimated cost, $160,000.

Ont., London—The Ruggles Motor Truck Co. has awarded the contract for the construction of a 2 story, 85 x 425 ft. factory on Dundas St. Estimated cost, $200,000.

Ont., London—The Service Motor Truck Co., Wabash, Ind., will soon award the contract for the construction of three 1 story, 100 x 300 ft. factories on Chelsea Green, here. Estimated cost, $250,000.

General Manufacturing

NEW ENGLAND STATES

Conn., New Hartford—D. S. Smith & Son plan to rebuild their cotton mill which was recently destroyed by fire. Cost to exceed $50,000.

Conn., Newton—H. Curtiss & Sons Co., Sandy Hook, has awarded the contract for the construction of a 1 story 30 x 40 ft. and a 1 story, 50 x 80 ft. factory with 30 x 40 ft. ell, on Foot Rd., for the manufacture of boxes. Estimated cost, $30,000. Noted Sept. 30.

Conn., Waterbury—The Dexter Baking Co., North Main St, has awarded the contract for the construction of a 2 story, 26 x 65 ft. bakery. Estimated cost, $25,000.

Conn., Waterbury—W. Nemiroff, 152 Hill St, will build a 1 story, 46 x 130 ft. garage on North Main St. Cost between $22,000 and $25,000.

Mass., Cambridge—L. Rubin, 543 Windsor St., will build a 2 story, 40 x 80 ft. factory for the manufacture of woolen waste. Estimated cost, $25,000.

Mass., New Bedford—The Whitman Mills Corp. has awarded the contract for the construction of a 2 story, 60 x 140 ft. addition to its waste building on Coffin Ave. Estimated cost, $75,000.

Mass., Somerville—The New England Breakfast Food Co., 29 Newberne St., will soon award the contract for the construction of a 3 story, 45 x 85 ft. addition to its plant on Lowell St. Estimated cost, $50,000. S. A. Smith, 27 School St., Boston, Archt.

Mass., Springfield—Tait Bros., Cass St., will build a 3 story, 40 x 165 ft. addition to their ice cream plant. Estimated cost, $60,000.

N. H., Nashua—The Asbestos Wood Co., 40 Bridge St., has awarded the contract for the construction of a 1 story, 90 x 220 ft. addition to its plant on Belknap St. Estimated cost, $50,000.

MIDDLE ATLANTIC STATES

D. C., Washington—The Washington Ice Mfg. Co., 3327 K St., N.W., plans to build an ice manufacturing plant on 23d and M Sts. N.W. Estimated cost, $200,000.

Md., Baltimore—The Baltimore Buggy Top Co., 107 West Mt. Royal Ave., has awarded the contract for the construction of a 3 story, 90 x 150 ft. addition to its buggy top factory on Guilford Ave near Chase St. Estimated cost, $100,000.

N. Y., Buffalo—The International Paper Co. plans to build a factory. Estimated cost, $75,000.

N. Y., New York (Borough of Brooklyn)—The Grand Corrugated Paper Co., 30 Crosby St., will soon award the contract for altering its factory on 32d St. Estimated cost, $50,000. P. Tillion & Son, 103 Park Ave., New York City, Archts. and Engrs.

N. Y., New York (Borough of Brooklyn)—The New York State Hospital Comn., Capitol, Albany, has awarded the contract for the construction of a 2 story, 50 x 70 ft addition to the laundry at the Brooklyn State Hospital here. Estimated cost, $450,000.

N. Y., Orangeburg—The Fibre Conduit Co. has awarded the contract for alterating its factory. Estimated cost, $10,000.

N. Y., Sheepshead Bay (Brooklyn P. O.)—C. A. Benoit, Jerome Ave., has awarded the contract for the construction of a chemical factory. Estimated cost, $150,000.

Pa., Philadelphia—Dill & Collins, Richmond and Tioga Sts., have awarded the contract for the construction of a 3 story, 28 x 58 ft. filter and pulp mill on Manayunk St.

Pa., Philadelphia—The Reyburn Mfg. Co., 23d and Alleghenny Sts., manufacturer of tags, has awarded the contract for the construction of a 1 and 4 story, 80 x 224 ft. manufacturing building, 80 x 340 ft. warehouse and 30 x 100 ft garage and power house.

SOUTHERN STATES

Fla., Key West—N. Thompson plans to rebuild his cigar box factory which was recently destroyed by fire. Estimated loss, $150,000.

La., Bogalusa—The Great Southern Lumber Co. has awarded the contract for the construction of an addition to its paper mill. Estimated cost, $250,000.

S. C., Graniteville—The Graniteville Mfg. Co. has awarded the contract for the construction of 3 story, 68 x 175 ft., Leaville McCampbell High School, to include a manual training department, etc. Estimated cost, $150,000.

S. C., Ware Shoals—The Ware Shoals Mfg. Co., manufacturer of cotton goods, plans to build a 3 story, 60 x 110 ft. plant, also a dairy and ice plant. Jackson & Moreland, 387 Washington St., Boston, Mass., Engrs.

MIDDLE WEST

Ill., Belvidere—The Rogers Grain Products Co. has awarded the contract for the construction of a grain elevator and mill, 30,000 cu. capacity. Estimated cost, $75,000.

Ill., East St. Louis—The T. J. Moss Tie Co., Security Bldg., plans to build a wood creosoting plant on Cahokia Rd. along the tracks of the Terminal R R. Estimated cost, $250,000. J. W. Fristoe, Pres.

O., Chillicothe—The Sears & Nichols Canning Co. will soon award the contract for the construction of a 1 story, 50 x 50 ft. canning factory. Estimated cost, $25,000. McMeans & Tripp, 510 Majestic Bldg., Indianapolis, Ind., Engrs.

Wis., Fort Atkinson—The Creamery Package Mfg. Co. will build a 3 story, 40 x 100 ft. factory. Estimated cost, $30,000.

Wis., Manitowoc—The Drost Box Mfg. Co., 1116 South 9th St., plans to build a 3 story, 120 x 260 ft. box factory. Estimated cost, $50,000.

Wis., Milwaukee—The Red Star Yeast & Product Co., 27th and St. Paul Sts., is having plans prepared for the construction of a 2 story, 27 x 100 ft. yeast manufacturing plant on 27th St. Estimated cost, $25,000. E. R. Liebert, 432 Bway., Archt. and Engr.

Wis., Sheboygan—The Phoenix Chair Co. has awarded the contract for the construction of a chair factory and dry kilns. Cost to exceed $35,000.

Wis., Sheboygan—The Tomah Rubber Co., c/o L. Hafmeister, 176 16th St., Milwaukee, has awarded the contract for remodeling its old plant and construction two 70 x 100 ft. units and boiler house in Lymans additions here. Cost between $50,000 and $60,000. Noted Aug. 5.

WEST OF THE MISSISSIPPI

Ark., Ft. Smith—The Harding Glass Co., Kelley Highway and North 11th St., plans to build a glass plant to cover 3½ acres. Estimated cost, $175,000.

Ia., Maquoketa—The Co-operative Creamery Co. has awarded the contract for the construction of a 1 story, 40 x 70 ft. plant. Estimated cost, $20,000.

Kan., Wichita—The Victory Mill & Elevator Co. is having plans prepared for the construction of a 7 story mill and elevator, 1,250 bbl. capacity. Estimated cost, $460,000. Sherman Eng. Co., 401 McMillan Bldg., Engr.

Mo., Kansas City—The Apie Brush Co. plans to build a 4 story factory at 610-14 Southwest Blvd. Estimated cost, $100,000.

Mo., St. Louis—The Sieloff Packing Co., 4339 Natural Bridge Rd., has purchased a site on Natural Bridge Rd. and Clarence St., and plans to build a packing plant. Estimated cost, $500,000. G. Sieloff, Pres.

Minn., Bemidji—Stellar Co. plans to build a 1 or 2 story addition to its turpentine and by-products plant. D. C. Brown, Secy.

Minn., Minneapolis—Sinclair & Collins, 2520 Fairwell Ave., have awarded the contract for the construction of a 1 story, 40 x 90 ft., addition to their laundry. Estimated cost, $12,000.

Neb., Lincoln—The Douglas Milk Co. is having plans prepared for the construction of a 4 story, 100 x 142 ft. dairy. Estimated cost, $200,000. J. B. Miller, 324 Little Bldg., Archt.

Okla., Bruner (Tulsa P. O.)—C. Page, Pres. of the Sand Springs Home, Sand Springs, plans to build a cement plant and large crusher, 1½ miles north of here. Estimated cost, $100,000.

Okla., Miami—L. B. Drake, Pres. of the School Bd., 519 Mining Exch. Bldg., has awarded the contract for the construction of a 3 story, 60 x 130 ft. addition to the School of Mines. Estimated cost, $95,000.

CANADA

Ont., Doon—The Doon Twines Ltd. plans to rebuild its factory which was partially destroyed by fire. Estimated loss, $150,000.

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